PROGRESS IN SOIL AND WATER CONSERVATION RESEARCH

a quarterly report

Soil and Water Conservation Branch
Agricultural Research Service
U. S. DEPARTMENT OF AGRICULTURE
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FOREWORD

Some suggestions from readers of the first of these new quarterly reports reached us in time to help in putting together this, the second report. However, all of the items were written before the comments started coming in any volume, and the summarized comments from SCS have been received during the final stages of work on this report. The comments received so far and all that come in the future will be carefully considered so that the reports can meet field requirements to the full extent possible.

Although it is probably understood generally by all who use these reports, it should be emphasized that the work done by the Soil and Water Conservation Research Branch is carried on jointly or in consultation with State Experiment Stations.

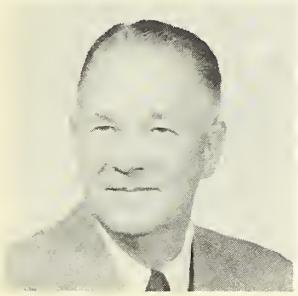
As stated in the first report, the material presented here is for in-service use only. This means the report should not be cited as literature, placed in libraries, or published. Some of the information presented is transitory and all is subject to professional interpretation and adaptation before use. The purpose of progress reporting such as this is to help professional workers keep in close touch with each other's work and ultimately to improve both the research and the application of research results for the benefit of farmers and the whole public.

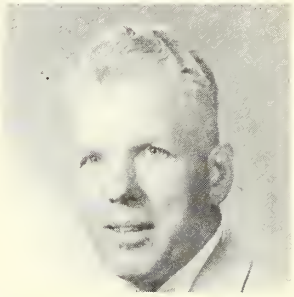
The Branch will endeavor to publish as promptly as possible all useful facts learned from its researches. However, inquiries regarding the status of individual projects with respect to publication will be welcomed.

STAFF MEMBERS
Soil and Water Conservation Research Branch

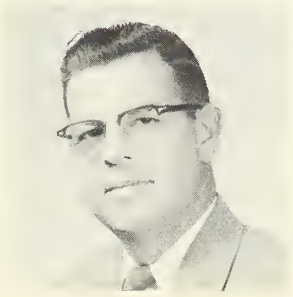


Left to right: William W. Pate, Assistant Chief of Branch; Chester E. Evans, Acting Head, Western Soil and Water Management Section; Harold F. Rhoades, Assistant Head, same section.





Left to right: Austin W. Zingg, Fort Collins, Colo. Technical Staff Specialist (erosion and moisture conservation), and Acting Area Supervisor, Western Soil and Water Management Section. Center, Rex Johnston, Amarillo, Tex., Area Supervisor, same section. Right, Bert A. Krantz, Huntley, Mont., Area Supervisor, also Western section.


Left to right: William W. Donnan, Fort Collins, Colo., Technical Staff Specialist (irrigation water supplies and conveyance), Western Soil and Water Management Section. Center, Howard R. Haise, Fort Collins, Technical Staff Specialist (irrigation and drainage), same section. Right, Milton Fireman, Riverside, Calif., Technical Staff Specialist (salinity and alkalinity), Western section, and Soil Chemist of U. S. Salinity Laboratory, Soil-Plant Relationships Section.

STAFF MEMBERS
Soil and Water Conservation Research Branch



Left to right: Three members of Eastern Soil and Water Management: W. H. Allaway, Beltsville, Assistant Head of Section and erosion control work project leader; T. W. Edminister, Beltsville, drainage work project leader; and R. W. Pearson, Auburn, Ala., soil fertility work project leader.



Left to right: H. E. Hayward, Director, and L. A. Richards, Soil Scientist, U. S. Salinity Laboratory, Soil-Plant Relationships Section, Riverside, Calif.; and Kenneth C. Beeson, Director, U. S. Soil-Plant Nutrition Laboratory, Soil-Plant Relationships Section, Ithaca, N. Y.



Left to right: Sterling B. Hendricks, Head Chemist, Soil Research Laboratory, Soil-Plant Relationships Section, Beltsville, Md.; Francis E. Clark, in charge of soil microbiology investigations, same laboratory. Right, L. W. Erdman, Beltsville, project leader on soil microbiology in Eastern Soil and Water Management Section and on legume inoculation studies in Soil Research Laboratory, Soil-Plant Relationships Section.

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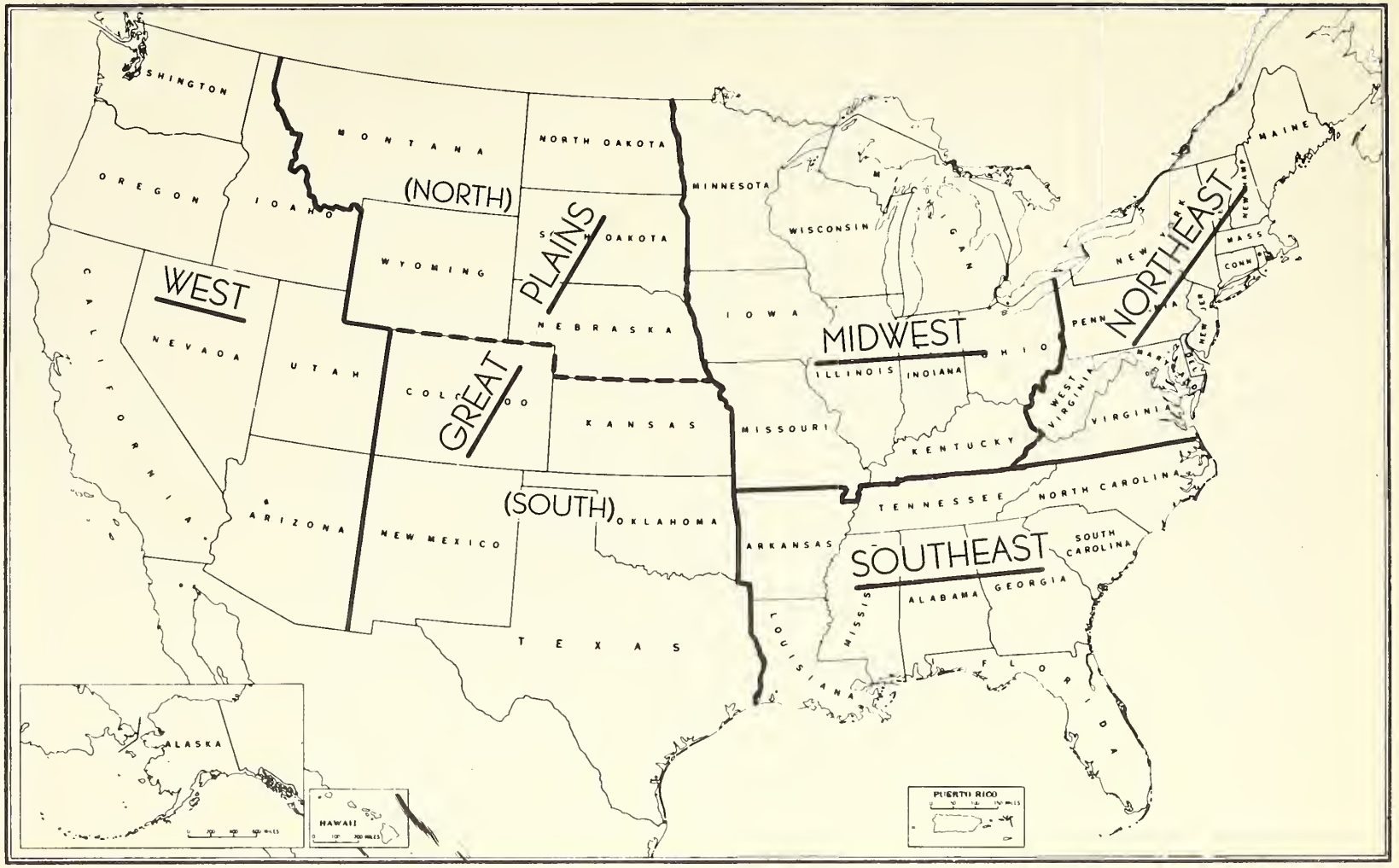
STATE GROUPINGS USED IN THIS REPORT*



* These groupings are used by Soil Conservation Service for plant technology servicing.

SOIL AND WATER MANAGEMENT

IRRIGATION

Northeast

Virginia. Irrigation of pastures. J. Nick Jones, Jr., Blacksburg.

Pasture Irrigation Increases Beef Production Three out of Five Years

Irrigation of permanent bluegrass-white clover pastures at Blacksburg, Va., increased yields in three of the last five years. No significant steer gain increases were obtained from two inches of irrigation water in 1949 or five inches in 1950 because of the favorable rainfall distribution throughout these seasons.

Irrigation totaling 7.4 inches in 1951 increased days of grazing per acre 43%. Average steer gains for the season were 320 pounds each on the irrigated lots and 288 pounds on the control areas.

In 1952, seven inches of irrigation increased annual steer gains from 152 to 222 pounds per head. Total grazing capacity was increased 49%. The carcass grade of the steers from the irrigated lots averaged "top good" (11.4), while those from the checks averaged "good" (10.2). Total gross return per acre from irrigation based on 1952 sale prices was about $50.

The most severe drought during the five-year period occurred in 1953. Eleven inches of irrigation was required. Pasture production was increased 60% on the irrigated lots. Likewise, steer gains were 42 pounds per head higher where the water was applied. Slaughter grade was increased from 9.8 to 11.6. Total gross return from irrigation, based on 1953 sale prices, was about $83 per acre. All of the results given were obtained from the bluegrass-white clover sod.

Pastures of orchard grass-Ladino mixture were added to the study in 1951. Since that date this mixture has given slightly higher returns per acre than the bluegrass white clover sod where irrigation was applied and more than twice the yields of the native sod where no irrigation was used. However, the 1953 drought, where no water was applied, severely damaged the legume in the orchard grass-Ladino mixture, thereby requiring early reseeding of the area to re-establish the proper grass-legume balance.

A high fertility level was maintained on all test areas. Grazing management provided ample forage for all animals at all times. Rotation grazing was followed on the orchard grass-Ladino clover lots.

Southeast

Alabama. Regional forage crop irrigation study at former SCS nursery, Thorsby. L. B. Nelson, Head, Eastern Soil and Water Management Section.

Research Team to Make Intensive Fundamental Study of Forage Irrigation

A new Southeastern regional forage crop irrigation research center is being set up at Thorsby, Ala., using a portion of the land on the old SCS nursery. The purpose of this

center is to conduct fundamental irrigation research with forage crops--studies that will be of value to other research locations and to farmers and technicians throughout the Southeast.

Problems to be attacked include water requirements and consumptive use of various forage species and mixtures; effects of irrigation upon stand establishment and growth and quality of the crop; the depth and rate of moisture penetration and depletion; development of sound companion practices, such as fertilization, liming, and other soil and crop management practices, for most effective use of moisture; investigation of methods, times and amounts of water application; determination of the best times to irrigate, and investigation of influence of irrigation on disease and insect incidence and control.

To conduct thorough research on these problems, a team of Federal and Alabama Experiment Station agricultural engineers, soil physicists, crops experts, and soil scientists will work at Thorsby. The Eastern Section will place more effort on the forage irrigation at this location than at any of its other locations. In fact, the total project will probably represent the most intensive approach on forage crop irrigation under humid conditions that exists anyplace.

Research at Thorsby should do much toward placing forage crop irrigation on a sound basis.

Midwest

Missouri. On-farm reservoirs as irrigation water sources, McCredie and Bethany. D. D. Smith, Columbia.

Irrigation Ponds Should Allow for Two Years' Storage in Central Missouri

In designing on-the-farm irrigation reservoirs, consideration must be given to the amount of evaporation and seepage losses and the drainage basin size required to provide a reliable water supply during drought periods.

Thirteen years of records ending in 1953 from the 157-acre mixed-cover watershed draining into the 16-acre reservoir at the Midwest Claypan Experiment Farm, McCredie, have indicated that 2 inches or more of runoff can be expected 24 out of 25 years. However, during the first eight months of 1954, runoff totaled only 0.16 inch.

Runoff records from the small watershed and terrace areas at Bethany during the period 1932-42, also indicated near zero runoff during one winter period.

From both groups of data, it appears that if ponds are to provide a reliable supply of water during severe drought periods, they should hold sufficient water for two consecutive irrigation seasons.

Water loss through evaporation and seepage may represent an amount equal to the amount required for irrigation, even with a favorable depth-area ratio for the reservoir.

Evaporation and seepage loss during 1953 from the 16-acre reservoir totaled 53 inches. This was 4 inches greater than in 1952 and 7 inches more than 1951. The greatest loss during any month since the study was started in 1951 was recorded in July 1954. It totaled 9.6 inches. Total loss for the first 8 months of 1954 was only one-half inch greater than for the same period of 1953.

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Ohio. Moisture extraction by potato plants. F. R. Dreibelbis, Soil Scientist, and L. L. Harrold, Project Supervisor, Coshocton.

Potatoes Take up to 0.26 Inch of Moisture per Day

Soil-moisture observations on the privately owned potato farm at West Lafayette, Ohio, showed maximum daily use of water as high as 0.26 in an 18-inch soil depth in the irrigated field. For irrigation-equipment design, 0.22 may be a more practical value at this time.

Maximum daily extraction of water from segments of soil profile by irrigated potatoes during periods of little or no rain, 1954

Period	Soil depth			
	0-18"	0-14"	0-10"	0-4"
	Inch	*Inch*	*Inch*	*Inch*
June 2-8	0.20	0.20	0.19	0.15
July 1-3	.26	.22	.18	.07
8-16	.26	.22	.08	.09

Moisture extraction patterns for three rainless periods totaling 16 days during July showed that the potato plants took most of their moisture from the top 10 inches of soil. This is shown in the following table.

Soil moisture extraction from irrigated potato land, 1954

Soil depth	Average daily rate of moisture depletion	
Inch	*Inch*	*Percent*
0-4	0.08	33
4-10	.11	46
10-14	.03	12
14-18	.02	9
0-18	.24	100

In the unirrigated potato field, soil moisture approached the wilting point at the 21-inch depth by June 20, at the 16-inch depth by July 10, and at the 12-inch, 7-inch, and 2-inch depths by July 19. Rain of 0.78 inch on July 21 replenished moisture to the 10-inch depth but not below. Wilting point values were again approached to this depth by July 28 after which rain penetrated to the 10-inch depth again. Moisture below the 10-inch depth remained at wilting from the dates indicated above until harvest.

Preliminary yield values for these potato fields are:

Irrigated--about 800 bushels per acre;
Unirrigated--about 300 bushels per acre.

Great Plains

Nebraska. Influence of different irrigation practices on production of field beans. O. W. Howe, Associate Agricultural Engineer, Scotts Bluff.

Field Beans Probably Often Over-Irrigated

Experiments on the irrigation of beans at the Scotts Bluff Experiment Station have indicated that this crop is often over-irrigated in western Nebraska. The data thus far collected are inadequate to explain all the variations in results from the different irrigation treatments.

In the growing season of 1953, rainfall was above average and only four irrigations were required to maintain the soil moisture below 400 cm. of water tension at the six-

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inch depth. The first, third and fourth irrigations were definitely beneficial. The second irrigation depressed yields even though the soil became very dry before the next irrigation was applied to those plots that did not receive the second irrigation. Weather was not cool and there was little rainfall at the time of the second irrigation although the humidity was higher than normal. The second irrigation was applied when the first pods were beginning to set on. The test does not show whether the unfavorable response of the crop to this irrigation was due to the stage of growth of the crop or to some other condition.

An experiment was conducted in 1954 similar to that of 1953 in which more detailed weather and other data were collected in an effort to define more precisely the conditions under which beans should or should not be irrigated.

Field work for the current experiment has been completed but the beans have not been threshed. Blight and bacterial wilt appeared early in the season but did not develop as rapidly as expected and probably did not affect yields greatly. These diseases appeared first and developed most rapidly in beans that were irrigated early in the season. The early-irrigated beans also matured more rapidly than those under delay and limited irrigation.

First pods began setting on plants on July 23. There were no appreciable differences among treatments in time of beginning of set.

First pods started turning yellow with maturity on August 16. First entire plots to become fully ripened were those that received irrigation early and little or no irrigation thereafter. Plots that received no irrigation during the first half of the season and frequent irrigation during the last half of the season ripened last. Extreme difference between first and last plots to become fully ripened was 17 days.

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Oklahoma. Preparation of land for irrigation; row spacing. H. H. Finnell, Goodwell.

New Irrigation-tillage Comparisons Started

In response to a consensus of farmer opinion in the immediate vicinity of the station, new studies were begun with the season of 1954, comparing listing, moldboard plowing, subsurface plowing, and disking as tillage methods to prepare land for irrigation. Row spacing studies using spacings of 14, 28 and 42 inches, with Westland milo and Atlas sorgo, were also initiated.

* * * * *

Colorado. Seepage from irrigation channels. A. R. Robinson, Ft. Collins.

Time-of-day Fluctuations in Seepage Investigated

Work at Ft. Collins. --It was noted in previous experiments that there was a fluctuation in seepage rates over a 24-hour period. This fluctuation, which was noted in several types of seepage measuring devices installed in different types of soil, was in some cases of considerable magnitude. In practically all cases the maximum seepage rates were measured when the water temperature was the lowest and the lowest rates at the highest water temperatures. This fluctuation became even more pronounced after the rates were corrected for viscosity to a standard temperature. From previous tests it was not possible to determine the factors which were responsible for this phenomenon. Since the equipment which was used in previous tests was still in place, this equipment was placed back in operation on September 1 to continue this study.

The tests are being conducted in "seepage rings." These rings consist of a tank 12 feet in diameter and 3 feet deep and filled with soil. A 6-foot diameter ring, 3 feet deep is placed in this larger ring so that 1 foot is below the soil surface. This leaves 2 feet of the smaller ring protruding above the soil; this area is filled with water. The water is maintained at a constant level, and inflow is measured into the ring. The three rings now operating contain three distinctly different types of soil.

For the effect-of-temperature tests, seepage determinations are made hourly over a 3-day period. These seepage determinations are made by filling the rings with water and checking the seepage by measuring the drop in water surface with a hook gage for hourly periods. The fluctuation in temperature in the previous tests was obtained by normal day-night temperature variations. Tests just completed again show the variations in seepage rates. Further tests will be made under controlled conditions.

Seepage studies at Grand Junction. --A seepage study was also made during the past quarter on the Grand Valley Canal near Grand Junction, Colo. Because of the high water table condition in the area it was desirable to determine the contribution of canal seepage to the ground water.

This study was made using the inflow-outflow method with current meter measurements and by using seepage meters. For the inflow-outflow measurements, sections of canal approximately 1 mile in length were used. Discharge measurements were made of all turnouts and wasteways in the section with portable weirs. Recorders were also installed in the section to assure that the measurements were made at a constant stage in the canal. Seepage meter tests were made at approximately 500-foot intervals along the center line of the canal.

The following tabulation shows the results of these tests:

Canal seepage rates: Cubic feet of water per square foot of canal surface per day, as determined by inflow-outflow method and by seepage meters

Canal section designation	Inflow-outflow method	Seepage meter method
	$Ft^3/Ft^2/day$	$Ft^3/Ft^2/day$
1 (4303 feet)	4.87	0.49
2 (5429 feet)	gain	0.56
3 (7262 feet)	0.66	0.17
4 (5052 feet)	0.27	0.09
5 (4487 feet)	0.46	0.23
Ave. (entire length)	0.68	0.30

The tests covered approximately 6 miles of main canal. A continuation of this study will be made by personnel of the ARS and the Colorado Agricultural Experiment Station who are stationed at Grand Junction.

* * * * *

Kansas. Irrigation of wheat. Walter Meyers, Garden City.

Wheat Irrigations Late in Growing Season Superior to Early Ones

One of the experiments this year was an irrigation study of wheat. The plots were arranged in level borders 50 feet x 50 feet; ten different irrigation treatments were used. Each irrigation treatment had four fertilizer treatments which were: Check, 50 pounds of N, 100 pounds of N, and 200 pounds of N.

Average yields for five replications of the various irrigation treatments and fertilizer treatments are shown in the following table.

Yields of wheat per acre associated with irrigation treatments and fertilizer treatments

Irrigation treatment		Fertilizer treatment			
Time of irrigation	Depth of irrigation	Check	50# N	100 # N	200# N
	Feet	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1-Pre-irrigation.....	3 1/2	34.7	33.8	36.4	34.6
2-Pre-irrigation.....	7	31.9	31.6	31.1	28.6
3-Winter.....	3 1/2	34.4	34.7	31.6	30.6
4-Winter.....	7	45.2	42.5	46.2	39.9
5-Late boot.....	3 1/2	45.2	46.3	41.5	39.5
6-Late boot.....	7	45.7	48.9	48.9	49.2
7-Winter & boot.....	3 1/2	41.7	37.8	38.0	34.9
8-Winter & boot.....	7	36.6	46.1	39.4	32.9
9-30% available.....	3 1/2	49.5	52.9	47.2	40.1
10-30% available.....	7	45.4	51.4	49.4	44.7

Highly significant differences were obtained between irrigation treatments but not between fertilizer treatments. The analysis of irrigation treatments indicates depth of wetting makes a difference in the early stages, with 3 1/2 foot wetting depth superior to 7 foot, but after the boot stage there is generally no difference. Irrigations late in the growing season and according to soil moisture conditions appear to be superior to early season water applications. Although the late boot stage (Treatment 6) gave the highest over-all yield, irrigations applied when the surface 2 feet was depleted to approximately 30% available moisture was not significantly lower and hence would be recommended.

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Montana. Effect of irrigation frequency on yield and water use of alfalfa. Torlief S. Aasheim, Huntley.

Water Table 5-6 Feet Below Surface--Alfalfa Responds Little to Irrigation

A high water table prevails on much of the Huntley Project but no information is available on the effectiveness of ground water in producing alfalfa in this area. This experiment was initiated in order to determine what effect the addition of varying amounts of irrigation water has on the yield of alfalfa hay under our conditions.

This work was started in 1953, and a summary statement from Dr. Larson's report for that year reads as follows: "Alfalfa yields were not greatly affected by irrigation when grown in a soil with a water table at about 5 to 6 feet below the surface. Apparently, deep-rooted crops can obtain enough moisture from the wet soil immediately above a water table to produce near maximum yields."

Total yields of alfalfa hay produced in 1953 were as follows:

Treatment	Tons per acre
1. 6 irrigations	6.7
2. 3 irrigations	6.7
3. No irrigation	6.3
4. 1 irrigation (early)	6.8

During 1954 the work was continued on these plots but with less detail. Water was not measured on and off, and the number of irrigations on the wet plots was not determined by farmer practice, which usually varies from 1 to 2 irrigations per cutting. Yields obtained this year were as follows:

Treatment	Tons per acre			
	1st Cut	2nd Cut	3rd Cut	Total
1. 2 irrigations between cuttings	2.5	1.4	1.3	5.2
2. 1 irrigation between cuttings	2.7	1.4	1.3	5.4
3. No irrigation	2.8	1.2	1.0	5.0
4. 1 irrigation early	2.8	1.3	1.0	5.1

There was considerable loss of stand on these plots during the winter 1953-54. The reason for this reduction in stand was not definitely determined but observation indicated that stand reduction was not correlated with treatment. This year's hay yields indicate quite a reduction in yield as compared with last year, but differences between treatments were similar to those of last year.

This experiment will be carried one more year to determine whether or not failure to irrigate for three consecutive years will result in a more serious reduction in yield than that experienced to date.

Data obtained during the past 2 years indicate that the use of supplemental water where a high water table prevails may not be justified.

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South Dakota. Irrigation investigations on the Redfield Development Farm, Redfield. Niel A. Dimick, Agent Irrigation Engineer, Brookings.

New Data on Consumptive Use Published, More Collected

Research pertaining to irrigation and drainage has been carried out here at State College Station and Redfield Development Farm for the past five years.

The data collected have been used as the basis of the circular "Soil Moisture Depletion by Irrigated Crops Grown in South Dakota," written by Leonard J. Erie and Niel A. Dimick and released by the Agricultural Experiment Station in August, 1954. This amends a bulletin by Erie, "Consumptive Use and Irrigation Water Requirements of Crops in South Dakota," published in the spring of 1952 by the Soil Conservation Service.

Results during quarter:

One irrigation each was applied to the barley and wheat crops when the grain was in the early dough stage. At this time the available moisture in the upper two feet of the root zone was depleted to a level of 20 to 30 percent. The crops showed no visible moisture stress. As computed from the soil moisture data, the depth of application for the one irrigation on the wheat was approximately 7 inches and on the barley approximately 4.5 inches.

Total moisture used by the wheat was 18.73 inches, which is approximately 2.5 inches more than was computed from data during the 1953 growing season. This may possibly be attributed to the weather conditions of the growing seasons of the two years as well as to a different variety of wheat which was planted in 1954 and which produced considerably better than did the wheat planted in 1953. The K value computed by the use of the Blaney-Criddle formula is .92, which is considerably higher than the assumed value (.75) in the bulletin written by Erie in 1952. However, with only two years of data, it does not seem advisable that a change in the K value be made as yet.

Barley used 16.90 inches of water. This is the first year that soil moisture studies on barley have been carried through a complete year. The computed K value was .88. This K value is also higher than the assumed value in the above-mentioned bulletin.

Following are two tables summarizing computed data for the barley and wheat crops:

Summary of data computed for barley and wheat during the 1954 growing season at Redfield Development Farm

Crop	Fertilizer application ($N-P_2O_5-K_2O$)	Yield per acre	Consumptive use	Consumptive use coefficient (K)	Length measurements
	Pounds	*Bushels*	*Inches*	*Index*	*Days*
Barley.....	40-150-0	54	16.90	.88	92
Wheat.....	40-100-0	38	18.73	.92	95

Water extracted from each foot of soil profile* by barley and wheat at Redfield Development Farm

Crop	0-1'	1-2'	2-3'	3-4'	4-5'
Barley:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1954.....	48	24	10	11	7
Wheat:					
1953.....	56	21	13	9	1
1954.....	51	15	15	9	10

*These data were determined only from these periods of the growing season when it was reasonable to assume the precipitation that fell penetrated no further than the upper foot and thus was consumed from this layer.

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Texas. Irrigation practices for cotton production. P. Earl Ross, Weslaco.

Cotton Responds About Same to 20 Inches of Water, No Matter When Applied

An Experiment to determine what effect soil moisture levels at different stages of plant growth have on the production of cotton was conducted during 1954.

Procedure.--In the experiment, the different soil moisture levels were depleted to 65%, 35%, and 15% of field capacity before irrigation water was added. The stage of plant growth at which the irrigation treatments were begun were (1) when the first square was visible, (2) when the cotton was in full bloom, and (3) when most of the bolls were more than one-half matured. Each treatment was replicated three times in plots 50 feet long and 8 rows wide. The soil on which the cotton was grown is a medium texture, deep sandy clay loam. The field capacity is 20% and the wilting range is 8%. The volume weight averages 1.5% for the top 5 feet.

Weather.--There were two significant interruptions in the irrigation and soil moisture level schedules. The first was a rain of 4.85 inches April 9, followed by showers of .74 and 1.18 inches during the following week. These rains brought the soil moisture level in all plots up to field capacity and, no doubt, account for much of the production in the treatments where irrigation water was withheld until 50% of the bolls were more than one-half grown. Second, the rain accompanying the tropical storm of June 25 also brought all plots up to field capacity. However, the hurricane came near the beginning of the har-

vest season and winds up to probably 70 miles per hour reduced production in all plots. Plots which had received less irrigation water lost considerably more open cotton to the storm than did the wetter plots; however, there was a greater loss of small bolls from the high moisture level plots than from the lower moisture levels.

Results --

1. Cotton yield was approximately the same where 20 or more inches of water was applied to the crop after the cotton was planted regardless of the stage of growth of the plant when the irrigation was applied. Grouping the averages of the high, medium, and low moisture levels, the following averages were obtained:

Seed cotton yields per acre, by number of irrigations and amounts of water applied

General Average moisture level	Average number of irrigations	Total water	Average yield
	Number	*Inches*	*Pounds*
High (A_3, A_2, & B_3)...	5.1	27.5	3296
Medium (B_2, C_3, & C_2)...	3	20.5	3086
Low (B_1 & C_1).....	2	17.5	2299

2. From these data it appears that the third irrigation of the medium plots increased production of one-half bale per acre over the two irrigations of the low moisture level plots. The current value of one bale of seed cotton is approximately $200 and the cost of one irrigation is approximately $7 per acre.

3. In the high moisture levels, an average production of 3296 pounds of seed cotton per acre was produced with five irrigations. Considering the increased hazards of insects, such as boll worms and weevil, the hazards of water management to prevent high water table and soil salinity, and difficulties in cultivation and defoliation, it is doubtful that the higher moisture levels actually showed any advantage over the medium moisture levels.

4. The outstanding treatment was the C-3 treatment which produced 3362 pounds of seed cotton per acre with only three applications of irrigation water, applied after approximately 50% of the fruit was more than one-half matured. It should be kept in mind when considering this treatment, however, that the rains in mid-April furnished excellent moisture throughout the profile at the time the cotton began to bloom.

5. It is felt that the actual significant differences in the performance of cotton under different soil moisture levels is not indicated in the data above. The differences in vegetative growth and actual setting of squares and small bolls were very outstanding throughout the season. The high moisture level treatment responded to each irrigation both in growth and fruit setting. However, the continuous shedding of squares and small bolls reduced the final yield to the level of the drier plots. Because of the excessive amount of stalk in the wetter plots, the insect control program, the defoliation costs, and the harvesting problems were all more difficult.

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Texas. Influence of grasses and alfalfa in the cropping system on water management of cotton. P. Earl Ross, Weslaco.

Grass and Alfalfa Influence Intake of Irrigation Water

Irrigation water management studies on cotton were continued this year on the outlying plots which H. J. Garrett made available for use on his farm near La Paloma. One-half of the area is devoted to grass and one-half to cotton. The area in cotton during this year had been in grass and alfalfa for the 2 1/2 preceding years.

Plots and procedure. --The irrigation system used in the studies consists of plots 640 feet long and 57 feet wide. The plots are level both parallel and perpendicular to the flow of irrigation water. They are enclosed with borders of sufficient height to prevent any uncontrolled water from entering or leaving the area. The irrigation water is delivered to the plots from a 14-inch alfalfa valve, and the size of the irrigation stream can be varied from 0 to 6 cubic feet per second. All irrigation water used on the plots is measured through a 12-inch Parshall flume, and all rainfall on the plots is measured by a recording rain gage. Soil moisture records are maintained by sampling the plots in depth increments of 1 foot to a depth of 5 feet. Samples are taken before and after each irrigation and at other intervals as necessary.

Results --

In the cotton plots which followed 2 1/2 years of grass, it was found that the water intake rate during the pre-planting irrigation was more than double that of the land which had not been in grasses. During the late season irrigations, however, the rate of water intake was not greatly increased over that which it had been prior to grass crop. Whether the reduced rate of water intake during the late season irrigation is a permanent phenomenon or whether it will again be high for the coming pre-planting and early season irrigations remains to be seen.

The actual water intake rate following 2 1/2 years of alfalfa for the pre-cotton planting irrigation was 1.7 inches per hour for the first 2 hours after irrigation water had been cut off and an average of 1.1 inches per hour for the entire 6-inch irrigation application. During the irrigation of June 11, the intake rate had dropped to .5 inch per hour for the first 2 hours, and the average for the entire 6.0 inch application was .40 inch per hour. Comparable data on the plots following Rhodesgrass were 1.0 inch per hour for the early season application and .66 inch for the late season. On adjacent plots before grass crops, the intake rates were .40 inch per hour for early season applications and .3 inch per hour for the later season.

Cotton Following Alfalfa and Grass Goes Deeper for Moisture

The depth to which the plants used soil moisture and the percentage of the total amount of moisture used in each foot were recorded for the season. Greater use of the deeper moisture was made by cotton which followed alfalfa and grasses than was previously made by cotton following cotton.

Percent of total soil moisture at various soil depths used by cotton following alfalfa, Harding grass and cotton

Depth	Following alfalfa	Following harding grass	Following cotton
Feet	*Percent*	*Percent*	*Percent*
0-1	31.5	32.7	44.4
1-2	25.0	22.1	31.8
2-3	17.2	22.0	5.1
3-4	12.7	15.7	0.0
4-5	13.6	7.5	18.7

From the above data, it is noted that following alfalfa about 44 percent of the total water used came from the 2- to 5-foot zone, while cotton following cotton used only 24 percent of its total moisture from the 2- to 5-foot zone.

Cotton's Consumptive Use of Water Not Much Changed by Rotation

Daily and seasonal consumptive use rates of water by cotton following grasses and legumes do not seem to be greatly changed from those of cotton following cotton if the entire season is considered. However, the daily use during the early growing season is rather low where cotton follows grass or legumes. The primary loss during this period is evaporation from the soil surface; the loss probably was reduced to some extent by the improved physical condition of the soil and reduced topsoil temperature due to undecomposed crop residue.

Water used by cotton following long-time rotation of perennial crops, 1954 season

Periods	Following Rhodesgrass	Following Harding grass	Following alfalfa
	Inches	*Inches*	*Inches*
Jan. 29 to Apr. 8	2.72	4.00	5.62
Apr. 8 to May 13	4.65	4.41	2.85
May 13 to June 4	4.86	5.13	6.34
June 10 to June 16	3.71	2.46	2.75
June 16 to Aug. 4	5.90	10.70	10.07
Total used	24.81	26.70	29.84

Average daily use of water by cotton following grasses and alfalfa

Periods	Following Rhodesgrass	Following Harding grass	Following alfalfa
	Inch	*Inch*	*Inch*
Jan. 29-Apr. 8 (69 days)	.04	.06	.08
Apr. 8-May 13 (35 days)	.13	.13	.08
May 13-June 10 (28 days)	.17	.18	.23
June 10-June 16 (6 days)	.62	.41	.45
June 16-Aug. 4 (39 days)	.15	.27	.25

Cotton Yields Higher Following Grasses and Alfalfa

The yields of seed cotton per acre in 1954 following the grasses and alfalfa rotation were as follows:

Following 2 1/2 years alfalfa - 3030 pounds
Following 1 year fescue grass - 2949 pounds
Following 2 1/2 years Harging grass - 2856 pounds
Following 4 years cotton - 2060 pounds

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Colorado. Reclamation of a saline-alkali soil of the Billings series. M. Amemiya, C. W. Robinson, and M. M. Hastings, Grand Junction.

Alfalfa on Saline-Alkali Soil Responds to Heavy Leaching

A leaching experiment was initiated in 1952 to study the effects of water and an amendment in the reclamation of a saline-alkali soil of the Billings series. Four treat-

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ments were considered in this experiment, as follows: (1) Leaching with 2 feet of water; (2) leaching with 2 feet of water plus gypsum, 4 tons per acre; (3) leaching with 6 feet of water; and (4) leaching with 6 feet of water plus gypsum, 4 tons per acre. These treatments were replicated four times, and arranged in a Latin square, each treatment plot being 30 x 60 feet.

Soil analyses showed that leaching alone brought about a significant decrease in soil salinity and alkalinity. The degree and effective depth of this decrease depended upon the amount of water used for leaching. The use of gypsum in combination with the leaching treatments did not affect salt removal.

In order to measure the effectiveness of reclamation by means of a crop response, all plots were seeded to Ranger alfalfa in the fall of 1953, after receiving a uniform application of treble superphosphate at the rate of 400 pounds P_2O_5 per acre. An excellent stand was obtained.

In 1954, three cuttings were made. Reclamation treatments apparently have affected the yield of alfalfa. It appears that gypsum applications had no effect when the soil was leached with 6 feet of water. However, when only 2 feet of water was used, gypsum began to affect yield.

Yield of alfalfa hay (oven dry weights) per acre as influenced by leaching and gypsum, 1954, Grand Junction, Colo.

H_2O used per acre to leach	Gypsum used per acre	1st Cut	2nd Cut	3rd Cut	Total
Feet	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
2	0	1.69	1.33	0.99	4.01
2	4	1.83	1.68	1.21	4.72
6	0	1.90	1.87	1.52	5.30
6	4	1.72	1.80	1.47	5.00

Observations made during the growing season indicate that yield differences may be attributed to (a) differences in the osmotic component of total soil moisture stress and (b) differences in soil physical condition affecting air-water relationships. It was found that where the plants were showing the most stress, soil moisture content was not necessarily lower than where the plants were healthy. Estimates of infiltration rates of irrigation water were as follows:

Treatment	Infiltration Rate Inches/hour
2' leaching	0.15
2' leaching plus gypsum	0.25
6' leaching	0.50
6' leaching plus gypsum	0.50

Soil analyses will be made to note changes, if any, in salinity and alkalinity occurring during the past cropping season and also for determining whether water in addition to crop requirement must be applied to maintain proper soil salt balance.

California. Irrigation water penetration problems in Tehachapi SCD.
Curtis E. Johnson, Bakersfield.

Volume Weight Measurements Indicate Possible Plow Pan

Several fields in this Soil Conservation District with rather acute water penetration problems were chosen for study. Tests of irrigation water from wells serving each site showed the water quality to be suitable for irrigation. Undisturbed 3 x 3 inch cylindrical soil cores were taken from a potato field for a determination of volume weights and percolation rates. The samples were secured from the bottom of the irrigation furrow and at a comparable soil level under the ridge between furrows. A preliminary summary of these tests is shown in the following table:

Comparison of volume weights and percolation rates in a potato field

Depth	Weight per cc.		Percolation rate per hour	
	Furrow	Ridge	Furrow	Ridge
Inches	*Grams*		*Milliliters*	
0-3	1.67	1.57	54	829
3-6	1.66	1.55	184	906
6-9	1.68	1.74	122	419
9-12	1.68	1.67	882	738
15-18	1.70	1.67	753	1255

The volume weight of the soil from the furrow is seen to be somewhat greater than that from the adjacent ridge. Yet, the pronounced increase in volume weight of the soil from the 6-9 inch depth under the ridge might indicate the existence of a "plow-pan" or compact layer, which could be caused from continuous tillage at about this soil depth. The percolation rate for this soil layer is much less than that of the layers immediately above or below. The 0-3 inch furrow samples have an intake rate of about one-fifteenth of those from under the ridge. This condition can be due to the sealing action of water on or near the soil surface or possibly to a somewhat dispersed soil condition. It is true also that this soil is very low in organic matter.

Recommendations for improving the compact soil condition include (1) the use of a chisel-type tillage implement to break the plow-pan, (2) the inclusion of deep-rooted crops such as alfalfa in the cropping system, (3) avoidance of all tillage operation when the soil is wet, and (4) reduction of tillage operations to a minimum.

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Idaho. Sprinkling as a method of applying water to irrigated farm lands.
Claude H. Pair, Boise.

Pressure Regulators for Sprinkler Systems Tested

Three commercial types of pressure regulators for use on sprinkler irrigation systems are under test. These regulators are designed to provide a constant pressure or a constant discharge at the sprinkler nozzle regardless of the pressures that may exist in the sprinkler lateral above that which the pressure regulators are set. Regulators such as these are of value for sprinkler systems used on steep or irregular topography where the pressure along a lateral may vary beyond the limits allowed by good sprinkler system design. Each sprinkler can be regulated to the same nozzle pressure or discharge regardless of the elevation differential between sprinklers. This gives a more even water distribution pattern over these fields than could be obtained in the past.

Typical relationships between the pressures obtained at the nozzles of sprinklers controlled by two of the pressure regulators and an uncontrolled sprinkler are shown in the following table:

Pressures per square inch at sprinkler nozzles, uncontrolled and controlled by two commercial types of pressure regulators

Uncontrolled	Pressure control regulator 1	Pressure control regulator 2
Pounds	*Pounds*	*Pounds*
53	28	32
49	26	34
44	26	33
39	24	34
34	24	32
28	22	28

The tests and observations of these regulators in actual operation showed that they function best in clean water. They become inoperative where the water carries fine sand.

The third pressure regulator studied is made to discharge a predetermined constant gallonage and did so under quite a variation in pressures and sprinkler nozzle sizes. For best results from this control device, the valve size number should be the same as the desired discharge of the sprinkler head at the optimum operating pressure. To illustrate: If the sprinkler is designed and operated to discharge 6 gallons per minute at 35 pounds operating pressure, than use a 6-gallon valve on the sprinkler.

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Oregon. Comparison of field measurements of infiltration rate with measurements in double ring infiltrometers. Fred Tileston, Ontario.

Infiltrometers Indicate Intake Rate Lower than Field Measurement in Test

A number of irrigation trials, using the Criddle method, have been run in eastern Oregon with the field infiltration rate checked against measurements obtained with double ring infiltrometers placed within and adjacent to the irrigated area.

One of the tests involved border irrigation on a coarse-textured soil with a high intake rate. The field measurements showed the field intake rate and the accumulated water intake to be somewhat higher than the infiltrometer measurements. The difference increased with the length of time that the irrigation water was applied.

Such tests, extended over a wide range of soil texture and structure, land slope, crops grown, and surface soil conditions, will measure the degree of correlation of the two methods used in determining field intake rates. If certain boundary limits for known soil and field conditions can be determined, the more simple infiltrometer measurements may be used with greater confidence as a guide for irrigation system and practice recommendations.

Midwest

Ohio. Erosion and water control practices. H. L. Borst, Wooster.

Manure Mulching Reduces Soil and Water Losses on Cornland in Ohio

Several years of soil and water loss measurements and yield data show that manure mulching is an effective erosion control practice in Ohio. In this practice, manure which ordinarily would be plowed under for corn is applied as a top-dressing after the corn is planted. Weeds can be effectively controlled by 2, 4-D sprays. The delayed mulching practice seems particularly desirable on soils slow to dry out in the spring.

Soil and water loss measurements were started on the old Zanesville station in 1945 and have been continued since 1947 at Wooster. The latter were plots, 6' x 25' or 30', and their short length naturally is favorable to the mulching. Two years of field trials, however, have shown that manure mulching accomplishes considerable erosion control where (1) the manure contains considerable strawy bedding material, which is resistant to decay during the growing season, and (2) the terrain is such that water does not concentrate in down-slope depressions. Of course, manure mulching does not provide protection between the time of plowing and the time of top-dressing.

Runoff and erosion from plots mulched with manure, annual July--August totals and average, 1945-53

Years	Rainfall	No manure mulch		Manure mulch	
		Runoff water	Erosion per acre	Runoff water	Erosion per acre
		Inches	*Tons*	*Inches*	*Tons*
1945	10.75	3.5	40.7	1.5	1.31
1950	9.75	3.6	2.7	3.0	.13
1951	9.61	5.7	1.7	2.2	.04
1952	7.45	4.0	7.1	1.7	.44
1953	5.63	3.8	9.7	.6	.39
Average	8.6	5.1	15.5	2.2	.58

Straw mulch compares well with manure. In corn yield trials 8 to 10 tons of strawy manure per acre were plowed under on the check plots and applied to the surface after planting on the mulched plots. Straw alone at 2 tons per acre has also been tested as a mulching material. Yield attained with manure mulch, compared with the same amount of manure plowed down in the conventional way, has varied from a 5-bushel yield decrease to an 11-bushel increase. The 8-year average increase from manure mulch vs. the same amount of manure plowed down has been more than 4 bushels. It is of interest that the straw mulch (no manure plowed under) has produced slightly higher yields than the manure mulch. Nitrogen added to the straw treatment did not increase production (a good legume sod always preceded the corn crop).

Corn yields per acre (at 15.5% moisture) associated with 3 mulches, annual and average, 1947-54

Year	Manure plowed down (8-10 tons/acre)	Manure mulch (8-10 tons/acre)	Straw mulch (2 tons/acre)
	Bushels	*Bushels*	*Bushels*
1947*	103	98	95
1948*	73	82	105
1949	119	119	118
1950	102	100	102
1951	92	103	103
1952	109	119	120
1953	82	90	97
1954	83	88	88
8 yr. av.	95.3	99.9	103.5
4 yr. av.	91.5	100	102

*Plots unreplicated prior to 1949.

Management system indicated. --In dry summers the average yield increase from mulching has been much higher than during normal or wet seasons.

Soil moisture has been somewhat greater in the mulched plots than in the unmulched. Application and management problems of manure-mulching are being studied. To date, the following system seems best: (1) plant, (2) rotary hoe or harrow, (3) apply mulch, (4) spray for weed control, (5) cultivate once at layby time.

The work re-emphasizes the need on sloping land for a type of row crop culture which protects the surface of the soil from the damaging effects of rainfall. The use of crop residues, waste hay, corn stover, and/or intercrops to accomplish this end should not be overlooked.

Corn yield differences associated with mulches and summer rainfall, 1947-54

Year	Deviation of May-Aug. rain from 15"	Difference between plowed-under and surface-applied manure	Difference between no mulch and straw mulch
	Inches	*Bushels*	*Bushels*
1947	+11	- 5	- 8
1948	- 2	+ 9	+32
1949	0	0	- 2
1950	+ 3	- 2	0
1951	- 2	+11	+11
1952	- 3	+10	+11
1953	- 3	+ 8	+15
1954	- 8	+ 5	+ 5

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Ohio. Moisture conservation methods. F. R. Dreibelbis, Soil Scientist, and L. L. Harrold, Project Supervisor, Coshocton.

Moisture Conservation in Mulched Corn Increases Yield

Mulch in corn strips resulted in increased yield in this very dry season. Manure mulch was applied by a standard type manure spreader when the corn was about 10 inches high. Hay mulch was applied late in June.

Practice	Yield per acre
	Bushels
Hay mulch.....	105
No mulch (check).....	96
Manure mulch.....	106
No mulch (check).....	90

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Indiana. New erosion control project. L. B. Nelson, Head, Eastern Soil and Water Management Section.

Quantitative Evaluations Sought for New and Old Erosion Control Practices

The Eastern Soil and Water Management Section and the Indiana Agricultural Experiment Station have completed plans for a new erosion control practices research program to start on January 1. Each agency is contributing to the support of the project, and the research will be jointly planned and conducted.

The new program is aimed toward developing and evaluating erosion control practices for use on steep lands which will permit maximum economic return to the farmer and at the same time keep soil and water losses to a safe minimum. In addition to time-tested conservation practices, the program will utilize all of the recent advances made in erosion control practices including mulching, sod seeding, wide-row spacing of corn with interplantings, high levels of soil fertility, tillage, etc. These will be combined and modified as necessary to develop sound systems of conservation farming.

Emphasis will be placed on developing soil loss equations in which each factor, such as slope length, degree of slope, soil type, and rotation, is given quantitative evaluation.

The entire project is aimed toward providing up-to-date information for use by technicians in conservation planning.

GREAT PLAINS

Nebraska. Influence of soil conditioners on runoff and erosion. F. L. Duley, Lincoln.

Effects of Soil Conditioner Persist but Fail to Equal Mulch

Experiments to determine the effect of a soil conditioner (HPAN) on intake and erosion on a Sharpsburg silty clay soil have been continued. These tests were started in May 1952 and the intake, runoff, and erosion have been determined at each rain since that time. The frequent rains in August gave an opportunity for numerous readings.

Results obtained since last report show that the soil conditioner applied in May 1952 is still having some effect on intake and erosion. In fact, the differences from the untreated land are similar to the results obtained the first year. This indicates a rather long lasting effect of the soil conditioner so far as intake of water is concerned. However,

it is still evident that the effect of the conditioner on intake and erosion falls far short of the effect of the straw mulch. The heaviest (HPAN) treatment, 4,000 pounds per acre, lost 4 times as much water by runoff and 24 times as much soil by erosion as did the plot with 5,000 pounds of straw applied in the spring of the third year.

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Nebraska. Conservation of soil through improved methods of harvesting field beans. Lionel Harris, Assoc. Agronomist, Scotts Bluff Experiment Station, Mitchell.

Bean Harvester That Will Not Disturb Soil Is Sought

High winds occur often during winter and spring over the irrigated area of western Nebraska. Present methods of harvesting field beans pulverize the surface soil and expose it to wind erosion. Great losses of highly productive soil occur annually as a result of wind action.

The Scotts Bluff Experiment Station, in cooperation with the Agricultural Engineering Department of the University of Nebraska, College of Agriculture, initiated a project in 1954 to determine possibilities of harvesting beans without disturbing the soil. If it is possible to harvest beans in this manner, cover crops such as fall rye, vetch, or sweet clover may be seeded with beans at the last cultivation. When seeded at this time, cover crops may be well enough established to hold the soil against wind action during the winter.

A pickup device was constructed to mount ahead of the cutter bar on a regular combine equipped with an improved spring tooth cylinder. Approximately two acres of beans were harvested with this machine. The beans were cut above ground and went directly into the combine.

When the beans were dry some shattering occurred ahead of the cutter bar. When the beans were green or damp the combine could not thresh them perfectly.

Methods of improving pickup devices to mount ahead of the cutter bar on combines were studied. Work on this project will continue next harvest season.

A bean cutting machine featuring a special pickup device and rotary blades powered by hydraulic motors was tested in several fields. This machine, made by the Hopkins Manufacturing Company of Saginaw, Michigan, cut the beans satisfactorily but disturbed the surface soil more than is desirable. The manufacturer plans to attempt to modify his machine.

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Oklahoma. Soil moisture and ground cover studies. H. H. Finnell, Panhandle A & M College, Goodwell.

Crop Failures Seen Due to Fluctuations of Rain Rather Than Fertility

Further investigation indicates that the frequency of crop failure due to violent fluctuations in the amount and distribution of rainfall rather than fertility of the soil accounted for low average yields. This variation in seasonal conditions appears to be characteristic of the Southern Plains in contrast to the Northern Plains and may also be related to the fact that the average amount of precipitation per rainy day increases markedly from north to south in the Great Plains.

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Kansas. Mechanics of wind erosion -- influence of soil moisture on erodibility. W. S. Chepil, Manhattan.

Cohesion of Water Films on Soil Particles Is Key To Wind Erosion

Deficiency of moisture is the basic cause of erosion of soil by wind. However, information has been lacking on the specific amounts of moisture that soils must have to resist wind. Research was undertaken in an attempt to supply some of the necessary data. Molecular attraction, known as tension, between over-dry soil particles is zero, or virtually so. An addition of slight amounts of water, not exceeding the hygroscopic coefficient, produces water films strongly adsorbed to the soil particles. Virtually all tension in these cases is at the soil-water interfaces and little, if any, at the water interfaces. These water films act essentially as part of the solid particles to which they adhere. Tension between these water films, if any, is too small to have a perceptible influence on erodibility by wind.

When increments of water greater than the hygroscopic coefficient are added, cohesion between the water films becomes perceptible. This additional water, therefore, may be considered free water, although capillary activity has not yet begun. Cohesion between the water films, and hence between the particles to which the films adhere, increases as more water is added and reaches the maximum when the adsorbed films have reached their greatest thickness. The soil pores are not necessarily completely filled when the films are thickest.

The rate of movement of soil particles by wind is reduced as the tension between the soil particles is increased and stops when the tension between the soil particles plus the force of gravity acting on the uppermost particles becomes equal to the force of the wind.

> Under atmospheric winds erodibility of soil reaches zero when moisture of the erodible particles is raised near or somewhat above the wilting point, depending on wind velocity.

It is evident that there are at least three zones of soil moisture in which molecular attraction of water is different: (1) dry zone dominated by strong adsorption of water films to soil particles, featured by little or no tension between the films, (2) damp zone manifested by cohesion between adsorbed water films, and (3) moist or wet zone featured by surface tension and capillary activity of water. However, no distinct dividing points seem to exist between the three zones. The force of an atmospheric wind against the soil surface is usually small compared to the surface tension of water; hence, only the dry and, to lesser degree, the damp soil particles are usually eroded by the wind.

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Kansas. Mechanics of wind erosion -- wind-blown soil abrasive injuries to winter wheat plants. N. P. Woodruff, Manhattan.

Winter Wheat Hurt by Blowing Soil More in Spring Than in Fall

A study of the abrasive injury caused by blowing soil to winter wheat plants was initiated in the fall of 1953. The plants were grown outdoors in plant flats, brought into the laboratory wind tunnel, and subjected to a blow-ing silt loam soil. They were exposed to three intensities of soil movement and, in addition, some of the plants were subjected to repeated exposures at close intervals. The extent of injury to the plants was measured in terms of wheat yield data, test weight, number of heads, and total weight of plant material produced.

Data obtained from this first year of study have been analyzed. While it is not believed that one year's data are sufficient to draw definite conclusions, the following points appear to be significant:

1. Wheat exposed to blowing soil in the spring receives much worse injury than wheat exposed in the fall.

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2. The wheat plant apparently has remarkable recovery powers if it receives moisture soon after severe damage. This was noted in the plants subjected to severe blowing in the spring. Nearly every tiller above the ground surface was killed, yet the plants given water produced some yield.

3. This study has shown a tendency for initial small amounts of blowing soil to result in a rapid decrease in yield and in number of heads produced. However, as the intensity of blowing is increased up to approximately 5,000 pounds per foot per day the yield also increases up to approximately 3 bushels per acre less than the checks. Then, with amounts greater than 5,000 pounds per foot per day, the yield decreases. No valid explanation of this can be given at the present time.

4. The total amount of material striking the plant appears to be more important than repeated exposures.

5. The effects of injury from the blowing soil was evidenced not only in the yield but also in total plant material, number of heads, test weight of grain, and uneven ripening of the grain.

This study will be continued for at least one more year. Particular emphasis will be given to obtaining data on rates of movement causing increased yields and more data on amounts of soil movement causing lethal damage to the plants.

SOIL FERTILITY

South

Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia. Project: Southern regional study to determine the present and potential need of sulfur for crops on Southern soils. Howard V. Jordan, State College, Miss.

Sulfur Deficiencies Observed in Many Parts of South; Intensive Study Begins

Sulfur deficiencies have been observed in many sections of the South, particularly on cotton and clover. With the increasing use of high-analysis, low-sulfur fertilizers, it was feared that widespread sulfur deficiencies might develop.

Field experiments with cotton and other crops were initiated at 23 locations. First year's results showed that cotton sometimes responded to sulfur additions during early growth. By harvest, however, all differences had disappeared. Analysis of the soils showed that the plow layer usually was low in sulfur but that considerably higher concentrations existed at lower depths. Thus, it appears that the young plants may be sulfur-starved until their roots reach the lower depths. It is not known how long the subsoil sulfur will support plant growth if only sulfur-free fertilizers are used. The field experiments are designed to give this answer.

Analysis of the rainwater collected at 64 locations indicates that only about 6 pounds of sulfur annually is brought down in rain at most locations. This is much less than is needed to meet the needs of most crops. Near coal-consuming industries, the sulfur content of the rainwater is much higher.

Several years will be required to fully investigate the sulfur problem and arrive at valid conclusions. In the end, we hope to have a fair idea of present and potential sulfur deficiency areas, how much sulfur as a nutrient will be required in each area for maximum crop growth, and the amounts and availability of sulfur in the subsoils.

Nebraska. To determine whether there is a response by fallowed winter wheat to nitrogen, phosphorus, or nitrogen plus phosphorus at moderate rates on land that has been cropped without legumes or amendments for 30 or more years. R. E. Ramig and F. E. Koehler, North Platte.

Response to Fertilizers by Wheat on Fallowed Land Varies by Years

For the five-year period 1950-54, the application of 30 pounds of nitrogen per acre has not increased winter wheat yields in an alternate wheat fallow cropping system at North Platte. Phosphorus fertilizer has given an average yield increase of approximately two bushels per acre. This increase would return slightly more than the cost of the phosphate fertilizer at current prices when protein premiums are not taken into consideration.

On an average, 30 pounds of nitrogen per acre significantly increased protein content (approximately 1.0 percent) while 30 pounds of P_2O_5 per acre decreased protein content about 1.0 percent. However, during the very wet year of 1951 the protein content of the grain was not significantly different due to treatment, and the grain from the phosphorus treated plots was highest in protein while that from the nitrogen treated plots was lowest.

The 1907-1954 (48 year) average rainfall for the period that the wheat is on the land (October 1 through July 31) is 15.18 inches. The rainfall for this period for the wheat crops was as follows: 1950--15.98 inches; 1951--24.52 inches; 1952--11.26 inches; 1953--9.98 inches; and 1954--11.08 inches. In 1950 and 1951, years of normal or above-normal precipitation, the check plots were lowest in yield, and the nitrogen-plus-phosphorus plots were the highest in yield with two-year mean yields of 26.0 and 30.6 bushels, respectively. However, in the three subnormal precipitation years (1952-54) when moisture was definitely limiting before maturity, the nitrogen plots were lowest in yield and the phosphorus plots highest in yield with three-year average yields of 26.9 and 31.6 bushels, respectively.

Yield response of fallowed Cheyenne winter wheat to commercial fertilizer as influenced by rainfall

Treatment N-P_2O_5-K_2O per acre	1950-51 mean yield per acre (normal and wet years)	1952-54 mean yield per acre (subnormal moisture years)
Pounds	*Bushels*	*Bushels*
0-0-0	26.0	29.0
30-0-0	29.0	26.9
0-30-0	26.5	31.6
30-30-0	30.6	28.3

Inspection of above table discloses that 30 pounds nitrogen per acre in years of normal or above-normal precipitation increases wheat yields about three bushels per acre while in years of inadequate moisture a yield reduction of about two bushels per acre occurs. In such dry years, 30 pounds of P_2O_5 per acre has given a yield increase of about 2.5 bushels per acre, but no yield increase from phosphate fertilizer occurs in years of normal or above-normal precipitation. Treatments receiving phosphorus generally head and ripen 4 to 6 days earlier than the other treatments.

This experiment is on Holdrege very fine sandy loam soil that has been cropped about sixty-five years without the use of legumes or soil amendments. In 1951 the average nitrogen content of the soil in the check plots was .094 per cent for the 0-6 inch depth and .090 per cent for the 6-12 inch depth.

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North Dakota. To determine the effect of fertilizers on yield of wheat under continuous cropping. Howard J. Haas, Soil Scientist, Mandan.

Wheat Yields Respond to Fertilizers at Mandan

In most of the years 1949-1954, inclusive, there has been a definite response to fertilizers on both soil types involved in the study.

The study has been conducted on Cheyenne fine sandy loam at the Northern Great Plains Field Station and on Williams silt loam leased from a farmer.

The data on Cheyenne fine sandy loam, Field H, show that the response is due mainly to nitrogen. Since these studies were all conducted on cropped land, it is not surprising that nitrogen should be the main limiting factor. If they had been conducted on fallow land, there would possibly have been greater response to phosphorus alone.

Until the last few years, farmers in this area have had little interest in fertilizers, however, lately there has been a definite increase in the use of fertilizers, and this increase will no doubt continue.

Yields were cut by hail damage in 1949, 1950, and 1954 and the crop was completely hailed out in 1951. How much this has influenced the differences between treatments is not known. A summary of results follows:

Yields of wheat per acre from fertilizer trials conducted at Mandan, N. Dak., under continuous cropping

Treatment[1]	1949	1950	1952	1953	1954	Mean
Cheyenne fine sandy loam--Field M VII[2]	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Check	10.4	8.7	15.1	14.2	12.6	12.2
NP	11.0	13.5	15.9	19.7	15.3	15.1
Cheyenne fine sandy loam--Field M VIII[2]						
Check	10.6	9.5	12.1	8.9	7.1	9.6
N	12.4	12.5	11.0	17.5	8.3	12.3
NP	13.7	13.2	10.4	17.3	13.0	13.5
Cheyenne fine sandy loam--Field H VI[3]						
Check	--	6.7	12.3	13.0	--	10.7
P	--	6.6	12.6	13.1	--	10.8
N	--	9.4	16.8	20.0	--	15.4
NP	--	10.7	17.2	21.8	--	16.6
Williams silt loam--Kalvoda farm[2]						
Check	7.2	11.0	16.1	5.9	7.9	9.6
NP	11.2	13.9	23.9	11.6	17.0	15.5

Note: Wheat on Cheyenne fine sandy loam was damaged by hail in 1949, 1950, and 1954, and was completely hailed out in 1951 on both soil types.

[1] N represents 30 pounds of nitrogen and P represents 30 pounds of P_2O_5 per acre.

[2] The yield each year is a mean of three replications.

[3] The yield each year is a mean of six replications.

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Kansas. To determine the effect of fertilizers on continuous wheat. Paul L. Brown, Ft. Hays Branch Station, Hays.

Applying Nitrogen Fertilizer with Seed in Dry Soil May Reduce Stand

Yields of wheat in 1954 from continuously cropped plots receiving applications of commercial fertilizers in the fall with the seed at planting time were as follows:

$N-P_2O_5-K_2O$ per acre	Yields per acre
Pounds	*Bushels*
0-0-0	25.7
0-30-0	27.7
30-0-0	17.2
30-30-0	26.2

This experiment demonstrated that applying nitrogen fertilizer with the seed in a dry soil may result in a reduced stand.

Stand reduction may have been caused by nitrogen-induced high osmotic concentration around the seed when the .48 inch of rain fell October 21 and wet the soil to the approximate depth of the seed. No explanation is offered as to why the same amount of nitrogen fertilizer in combination with the phosphate did not also result in a stand reduction. Such a stand reduction due to drilling nitrogen fertilizer with the seed had not been recorded previously at the Hays station. If wetting the dry soil only to the depth of the seed is responsible, we should be concerned with how often this occurs. Rainfall records indicate such might occur about once in four years.

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South Dakota. To study the effect upon spring wheat of nitrogen and phosphorus fertilizer applications to the soil. A. Osenbrug, Newell Irrigation and Dry Land Field Station, Newell.

1954 Spring Wheat Yields in South Dakota Aided by Fertilizers

The experiment was initiated in 1950. Fertilizers were applied in the spring each year to the same group of plots which were continuously cropped to spring wheat. A pronounced growth response to nitrogen and nitrogen-phosphorous fertilizer applications occurred each season, but this advantage was counteracted to a large extent by more severe drought injury as the season advanced, and increases in grain yield were relatively small or non-existent, except in the unusually favorable year of 1953.

The superiority of growth on plots receiving nitrogen fertilizer was more pronounced in 1954 than in 1953, but drought injury occurred earlier in the season and was more severe. Spring wheat grain yields generally were 30 percent or more below average but wheat made a definitely favorable yield response to nitrogen and nitrogen-phosphorus treatments.

Summary of yield and pertinent agronomic data for spring wheat grown in the simple fertilizer experiment at Newell, South Dakota, in 1954

Annual fertilizer application per acre		Plant height	Test weight per bushel	Yield per acre	
Nitrogen	P_2O_5			Straw	Grain
Pounds	*Pounds*	*Inches*	*Pounds*	*Pounds*	*Bushels*
30	60	37	50	2620	13.8
30	0	34	50	2301	12.8
0	60	29	54	1180	9.8
0	0	27	54	1176	10.0
			L.S.D.	.05	1.9

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South Dakota. To determine the initial and residual effects of various nitrogen fertilizer and manure applications upon the yield and protein content of grass. A. Osenbrug, Newell.

Residual Effects of Fertilizer Practice Noted on Grass After 3 Years

Treatments included annual broadcast applications of ammonium sulphate to old stands of crested wheatgrass at 20, 40 and 60 pounds nitrogen, manure at 8 tons, and manure plus ammonium sulfate at 20 pounds nitrogen per acre. The fertilizer and manure were applied to the same group of plots each year from 1948 to 1951, inclusive.

Yield and protein content of hay were definitely increased by the various treatments during the initial 4-year period, but the yield increases were not sufficient to cover cost of fertilizers or manure. The greatest and most efficient yield response was obtained from the 60-pound annual nitrogen application. Yields from plots receiving manure alone were roughly equivalent to those from plots receiving 20 pounds of nitrogen.

Residual nitrogen from all applications of ammonium sulphate materially increased the yields of hay until 1954. Practically no yield increases were apparent in 1954 from the 20 and 40 pound annual rates for nitrogen, except where ammonium sulphate was applied with manure. Sufficient residual nitrogen remained from the 60 pound nitrogen rate to have a definitely favorable influence upon yield in 1954. Manure maintained a substantially higher level of production than the various applications of ammonium sulfate. The yields obtained in 1954 are included in the following table.

Yields per acre of hay (air dry) obtained from various treatments in grass fertilizer experiment in 1954

Treatment per acre (Annual applications, 1948-51)	Yield
	Pounds
0 (check)	803
20 # N	905
40 # N	879
60 # N	1214
Manure, 8 tons	1285
Manure plus 20 # N	1514
L. S. D. .05	127

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South Dakota. To ascertain the residual effects of fertilizers on alfalfa yields. Conducted on Belle Fourche irrigation project. Bruce L. Baird, Newell.

1954 Alfalfa Responds to 1951 Fertilizer Applications

The residual effect of the treatments made in 1951 was evident in the first crop of alfalfa harvested in 1954. The increase in yield attributed to phosphorous was as great in 1954 as previously for all rates of phosphate except for possibly the 60 pound application.

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New Mexico. To develop a sound phosphate fertilization program for the soils of the Tucumcari irrigation project, which are generally low in available phosphorus. Ralph E. Campbell, Northeastern Substation, Tucumcari.

Heaviest Rates of P_2O_5 Best for Alfalfa

The experiment discussed here was designed to determine the most effective phosphorus fertilization program for a rotation and to correlate some of the laboratory methods of assessing the phosphorus status of the soil and the crop response obtained from added phosphorus. One of the primary objectives is to evaluate the effect of different rates of phosphorus fertilization on the growth of alfalfa through the season and the three seasons following the initial fertilizer application.

In the spring of 1951, a six year fertilized rotation experiment was set up on this station. The rotation included four years of alfalfa, one year grain sorghum and one year sugar beets.

All fertilizer was applied before the alfalfa was seeded in the spring of 1951. The fertilizer used was treble superphosphate (45% P_2O_5) and was applied at the following rates of P_2O_5 per acre: (1) none; (2) 60 pounds; (3) 120 pounds; (4) 240 pounds; (5) 480 pounds.

This year is the last of four years of alfalfa in the rotation. Although this year's data are not yet complete, they are sufficient to show the developing trends.

Three crops of hay were harvested from the experiment in 1951. Five cuttings were made in each year following except this year in which four cuttings have been made. The fifth cutting is to be made.

Each year a striking response to fertilizer has been shown. Results from the first year indicated that 60 pounds P_2O_5 is not sufficient to maintain yields at a high level through one season. The yields resulting from the heaviest phosphate application have held consistently high in comparison to yields from other treatments. The lighter yields in 1954 may be at least partially the result of hail damage to one crop and yellow clover aphid damage to two others. Yields from the lighter applications have dropped successively.

Yields obtained from this experiment through the four years in which it has been under observation are shown in the following table.

Yields of alfalfa hay (air dry weights) per acre from phosphorus fertilizers applied in 1951, by years and treatments, with totals

P_2O_5 per acre	1951 3 cuttings	1952 5 cuttings	1953 5 cuttings	1954 4 cuttings	Totals 17 cuttings
Pounds	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
0	1.88	1.55	0.71	0.33	4.47
60	2.62	5.10	1.50	0.61	9.83
120	2.95	7.31	4.72	1.20	16.18
240	2.97	7.74	6.90	2.20	19.81
480	3.00	8.27	8.57	5.12	24.96

Yields obtained from the 480 lb. P_2O_5 application would naturally be expected to drop in coming years. The carryover from all treatments will be measured on the sorghum crop in 1955.

Up to this time, the heaviest treatment has been shown to be the most economical of those used. This conclusion is based on the net return from the investment made in fertilizer.

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Montana. Exploratory study with anhydrous ammonia in central Montana. Ralph M. Williams.

Response to Anhydrous Ammonia Best on Re-cropped Land at Medium Rate

Rates of 30, 50 and 70 pounds of 82% anhydrous ammonia were used on re-cropped barley, re-cropped spring wheat, fallowed spring wheat and burned spring wheat stubble. Precipitation received during the 1954 growing season was above normal by 1.47 inches. However, there was some drought during July and severe hail in August. Normal seasonal precipitation for the period April 1 to September 30, inclusive, is 11.16 inches. There were 12.63 inches of precipitation during 1954.

From observation and the data from six trials in an area approximately 50 miles in radius from the station, it is evident that there were greater increases in yield from re-cropped land than from fallow land. The 50-pound rate of NH_3 (41-pounds of N) appeared to be the most satisfactory of the rates used.

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South Dakota. To study soil fertility practices on irrigated land. Redfield Irrigation Development Farm and private farms on Angostura project. Lawrence O. Fine, College Station.

Fertilizer, Legumes, Close Spacing Important in S. Dak. Irrigation

Field experiments with rotations, various fertilizer applications, irrigated and non-irrigated crop performances and soil and crop management techniques were begun at the Redfield and Huron irrigation development farms in 1949. In 1953 and 1954, work has also been done on farmer-cooperator lands on the Angostura project. The major findings of these experiments to date are briefly as follows:

1. Much N needed on cut land. --On newly leveled land, particularly where cutting to any extent was necessary, large quantities (100 to 120 pounds) of fertilizer nitrogen and similar amounts of fertilizer P_2O_5 were required to attain reasonable levels of production. Large applications of manure (40 tons per acre) did not result in satisfactory yields of oats, corn, or potatoes on Beotia silt loam soil.

2. Red clover helps. --On Barnes loam of the Huron farm application of commercial fertilizer nitrogen and phosphorus did not result in appreciable yield increases of barley, oats or corn when these crops followed red clover, plowed down. The soil on these experimental sites was only slightly cut in the leveling operations. The A horizon of the Chernozem soils involved in these experiments is 10" - 14" in thickness, and when half or more is removed, severe nitrogen deficiency develops in the cropping systems normally used until legumes have been raised on the land.

3. Grass needs N. --Commercial fertilizer use on introduced grasses sown in close-drilled rows (6-8 inches) resulted in yield increases of both hay and seed. Rates of nitrogen up to 160 pounds per acre per year have proved economical. In fact, costs per pound of protein produced were lowest at the highest rate of nitrogen application. The use of alfalfa sown with grasses such as brome, intermediate wheat, Reed canary, orchard, and tall oat grass has resulted in as much forage production and protein production per acre as the use of 80 pounds of nitrogen per acre per year on grasses sown alone.

4. Water means yield. --In comparisons of irrigated and non-irrigated rotations, with and without alfalfa, supplemental irrigation has increased hay yields 60 to 100%, corn yields 40 to 300% and more, and wheat yields from 10 to 45%.

5. 20,000 corn plants needed on irrigated land. --Corn studies have shown the need of approximately 20,000 plants per acre fertilized with 60 - 80 pounds of nitrogen, with slight advantage of drill planting over hill planting. Studies on the irrigation requirements showed most critical requirements for water to be in the tassel to mid-milk stage of development. There is little or no need of commercial nitrogen fertilizer for corn the first year after alfalfa in a rotation.

6. Space soybeans close. --Soybean management experiments have shown a distinct yield advantage for rows spaced at 18" rather than 36" for furrow-irrigated conditions, and even 9" when border irrigation can be used. Furrow maintenance in 9-inch rows proved to be impracticable by machine methods. Irrigation increased soybean yields by 10 to 14% in the years 1952 and 1953.

During the last quarter the following results were obtained:

1. In new rotation experiments, barley yield in a barley-corn-corn rotation increased approximately 30% in response to nitrogen at 40 pounds per acre. The base yield for control plots was 38 bushels. However, no consistent yield response resulted in a parallel rotation containing alfalfa. Irrigation doubled the yield of Selkirk wheat when grown without nitrogen fertilizer and without benefit of alfalfa in the rotation. However, nitrogen at 30 pounds per acre or alfalfa in the rotation raised yields from 16 bushels to 31 and 27 bushels, respectively, in non-irrigated plots.

2. On irrigated Beotia silt loam soil at Redfield, only orchard grass and, to a lesser extent, Reed canary grass, have persisted to any extent after 3 years of growth in association with alfalfa. Brome grass, tall oat grass and intermediate wheat grass have almost completely disappeared from stands of alfalfa-grass which originally had excellent stands of grasses. The management has been fairly typical of that used for hay production.

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Texas. To learn how to make satisfactory compost from cotton burs.
R. J. Hervey, Temple.

Cotton Burs Compost Well with Castor Bean Pomace at 4:1 Ratio

Final results are now available from a bur composting experiment in which castor bean pomace was used as the nitrogen source.

Cotton bur and castor bean pomace are by-products for which little or no use has been found. Since cotton bur has a wide carbon-nitrogen ratio (about 1:60), it is difficult for microorganisms to decompose it. Castor bean pomace, on the other hand, is relatively high in nitrogen (28% protein, 4.5% N) and was, therefore, used as a source of N to speed up decomposition of the bur. The results indicate that a bur-pomace ratio of 4:1 is about the best proportion to use. Microbial numbers were highest, total N content was

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relatively high and extent of decomposition was as good as at any other ratio used. Moreover, loss of nitrogen by denitrification (not shown) was the lowest of all treatments, being only 16%. By contrast, 47% of the original N was lost where ammonium sulfate was employed; where the bur-pomace ratio was 2:1, 38% of the original N was lost during decomposition. From the standpoint of N conservation, therefore a bur-pomace ratio of 4:1 appears to be best.

Cotton bur composts: Microbial content, total nitrogen content and extent of organic matter decomposition after incubation of 32 and 52 days

Treatments	Microbes per gram		Total N		Original bur weight lost	
	32 days	52 days	32 days	52 days	32 days	52 days
	Billions		*Percent*		*Percent*	
Bur alone (control).....	8.9	7.7	1.65	1.79	33	38
Bur 2 parts, pomace 1 part.....	7.9	8.0	3.39	3.48	37	48
Bur 3 parts, pomace 1 part.....	11.3	6.9	3.12	3.37	44	49
Bur 4 parts, pomace 1 part.....	14.1	9.3	2.86	3.26	40	49
Bur + $(NH_4)_2SO_4$ (2% N).....	7.8	12.5	2.92	3.25	42	48

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North Dakota. Forage production of irrigated Russian wildrye as influenced by row spacing and fertility. George A. Rogler and Russell J. Lorenz, Research Agronomists, Forage and Range Section, Field Crops Research Branch. Mandan.

Row Spacing Affects Fertilizer Response of Irrigated Wildrye in 1954

Previous work with Russian wildrye has shown it to be one of the highest potential yielders of all grasses and legumes adapted for use under irrigation in the area. Forage from this grass also carries an exceptionally high level of protein and minerals. Since cultural methods and fertility levels appear to be quite critical for maximum forage production, study was undertaken to determine the effects of different row spacings and fertility levels on production.

The plots were seeded on June 10, 1953, in a randomized split plot design with four replications. The main plots were spacings of 6, 18, and 36 inches and the sub-plots were nitrogen levels of 0, 100, 200, and 400 pounds per acre. A uniform application of 200 pounds of P_2O_5 per acre was applied prior to seeding. Nitrogen fertilizer was applied in split applications of four equal parts. The first application was in the late fall of 1953. The other applications followed each of the three cuttings. Adequate irrigation water was applied during the entire season.

Three forage cuttings were taken during 1954. The first was at flowering stage on June 16 and the other two on July 26 and September 21. Total seasonal yields are shown in the table.

Fertilizer response was quite evident especially in the 6-inch and 18-inch spacing. As the planting becomes older, it is quite likely that nitrogen will also give a response in the 36-inch spacing. In all cases except the check the 18-inch rows gave the highest yields. First cutting yields were much higher than the second and third cuttings. The grand averages per cutting in tons per acre were 2.51, 1.25, and 0.88 respectively.

Results herein reported are preliminary, as they cover only one year's data. It is expected that yields will increase at least in 1955 and 1956. Additional information will be secured on the amount of protein and phosphorus as influenced by the various fertility

levels. Data will also be obtained on root production at the different spacings and fertility levels.

Seasonal forage yields per acre (hay at 12% moisture) in 1954 from three cuttings of Russian wildrye planted at three row spacings on four nitrogen levels under irrigation at Mandan, North Dakota

Nitrogen per acre	Row spacing			
	6 inches	18 inches	36 inches	Average
Pounds	*Tons*	*Tons*	*Tons*	*Tons*
0	3.79	3.98	4.04	3.93
100	4.08	4.98	4.06	4.37
200	5.35	5.26	4.30	4.97
400	5.32	5.67	4.30	5.10
Average	4.63	4.97	4.18	4.59

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North Dakota. To ascertain fertilizer requirements of irrigated corn on leveled Gardena very fine sandy loam. Carl W. Carlson, D. L. Grunes, L. R. Jensen, J. Alessi, and F. Turner, Jr., Mandan.

N, P_2O_5, Zinc Needed to Overcome Effects of Leveling

An experiment was set up on an area from which the surface soil had been removed to facilitate gravity irrigation (cut area). A companion experiment was included on soils which had not been cut. Treatments included nitrogen, phosphorus, barnyard manure, and zinc. Corn was used as the indicator crop.

The results of the silage yields on the cut area were as follows:

(a) The greatest response occurred in the treatment which included nitrogen, phosphorus, and barnyard manure.

(b) Nitrogen fertilizer alone increased yields while phosphorus fertilizer alone did not.

(c) Nitrogen and phosphorus together gave a bigger response than nitrogen alone.

(d) Treatments which did not include zinc or barnyard manure produced plants showing varying degrees of zinc deficiency.

(e) Barnyard manure alone did not give yield increases as great as treatments of nitrogen and phosphorus fertilizer applied together.

The results of the experiment on the non-cut area showed that:

(a) The yield response to nitrogen, phosphorus, and barnyard manure was significant but to a lesser degree than on the cut area.

(b) The nitrogen alone treatment gave yields as high as the treatments which included nitrogen and phosphorus.

(c) Barnyard manure alone did not give a significant increase in yield.

(d) No zinc deficiency symptoms were observed on any treatment.

A comparison of the two experiments indicates that the yields of the unfertilized plots were much lower on the cut areas than on the undisturbed soil. The addition of manure and nitrogen, phosphorus and zinc fertilizers increased the yields on the cut area so that they were comparable to the yields obtained on the fertilized non-cut soil.

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North Dakota. Fertilizer response of plants grown on Ulen soils in the greenhouse. D. L. Grunes, and W. M. Brewster, Mandan Development Farm.

Ulen Soils in Greenhouse Show Need for Both N and P_2O_5

Soils were obtained from the East Souris loop in North Dakota and among those Missouri Basin soils which are considered most feasible to irrigate from the standpoint of good drainage conditions. The present experiment was set up to obtain preliminary information on fertilizer response.

To prepare land for gravity irrigation, soil leveling involving removal of some surface soil is carried out. Therefore, in this experiment, an attempt was made to determine the fertility status of the sub-surface layer of one of the top soils used.

Soil properties indicate that the Ulen very fine sandy loam surface soil (50M117) is considerably higher in nitrogen and phosphorus fertility than is its corresponding subsoil (50M118). The Ulen loamy sand (50M119) is rather low in nitrogen fertility, and is lower in phosphorus fertility than either of the other two soils. Free calcium carbonate is present in the surface soil of Ulen very fine sandy loam and still more in the subsoil. The paste pH is fairly high for both soils. While still above the neutral point, the pH of the Ulen loamy sand is lower than that of the other two soils, and there is little free calcium carbonate.

On the Ulen very fine sandy loam surface soil considerable growth response of Romaine lettuce was obtained to the application of nitrogen, while response to phosphorus alone was very small. Some additional growth response to phosphorus was obtained at the higher nitrogen level.

The crop grown on the subsoil responded markedly to applications of nitrogen alone but not to applications of phosphorus alone. The largest yields were obtained with a combination of nitrogen and phosphorus fertilizers.

Lettuce on Ulen loany sand responded to applications of nitrogen alone but very little to phosphorus alone. Marked yield increases were obtained when both nitrogen and phosphorus were applied.

The addition of potash did not appreciably increase plant growth on any of these soils.

It is interesting that even when nitrogen, phosphorus, and potash fertilizers were applied to the subsoil, the yields were still smaller than on the comparable topsoil. Possible causes of this difference may have been a minor element deficiency or physical problems in the subsoil, or that the rates of fertilizer application to the subsoil were not sufficiently high to obtain maximum yields. A minor element deficiency is probably the main cause.

As a result of these tests, the following predictions are made for plant growth response in the field:

Ulen very fine sandy loam surface soil will likely require applications of nitrogen fertilizer but not applications of phosphorus alone for optimum crop growth. If both nitrogen and phosphorus are added, some yield increases above those due to nitrogen alone may be obtained.

If the topsoil is removed to facilitate gravity irrigation, the subsoil will almost certainly require applications of nitrogen fertilizer for optimum yields. Applications of phosphorus alone will almost certainly not be effective for increased yields. However, applications of nitrogen plus phosphorus are likely to increase the yields above those obtained by the addition of nitrogen alone.

The Ulen loamy sand should give field response to nitrogen fertilizer. Response to phosphorus alone is possible but not very likely. Field applications of both nitrogen and phosphorus would be necessary to obtain maximum yields.

None of the soils appear likely to give any growth response to field applications of potassium fertilizer.

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Colorado. To make high altitude mountain meadows more productive. Hayden K. Rouse, Forrest M. Willhite, A. Ray Harris, Eugene G. Siemer, Gunnison, Grand Junction, Fairplay, and Hayden.

High Protein Hay Pelleted for Feeding Tests

Gunnison. --Work in 1952 and 1953 on small plots showed that a two-cutting hay harvest with annual applications of 480 pounds of nitrogen per acre would produce high yields of hay approaching a 20% crude protein content.

Local practice in wintering cattle in the mountains is to provide a supplemental ration of high protein feed such as cotton-seed cake, alfalfa pellets, etc. Most of this supplemental feed contains from 17% to 41% crude protein, with a fair proportion designated 20%.

It is possible that ranchers might utilize a portion of their land to produce high quality hay to feed as a supplement with their ordinary hay at a considerable saving; however, no data were available as to palatability of such hay or the reactions of cattle to it or the production possibilities under field conditions. Accordingly, an animal nutrition experiment has been designed for animals to be fed during the 1954-1955 winter. One pen of ten heifer calves will be given pelleted high protein hay as a supplement to a standard hay ration in comparison with similar pens given the conventional cotton-seed cake and alfalfa pelleted supplements.

In preparation for this experiment, hay was produced during the summer of 1954 on a field of approximately one acre, which was fertilized in May with 400 pounds N per acre. A first cutting on June 22 produced 1.6 tons (oven dry) per acre of hay with 20.5% crude protein. A second cutting on August 7 produced 1.6 tons per acre with 15.6% crude protein. A heavy growth following the second cutting was left for pasture. These hays will be pelleted and fed during the 1954-55 winter feeding season.

Heifers Gain More on Fertilized than on Non-Fertilized Pastures

Green Mesa Ranch, in Parlin. --This experiment is being conducted on meadows at an elevation of about 8,000 feet. The complete experiment is designed to compare, eventually, the economy of nitrogen fertilization versus no treatment in the final product of mountain ranches--that is, in the calf crop. The experiment utilizes the better practices in water management and time of harvest as developed from the Blackstock factorial experiment and includes both irrigated pasture for summer feed and meadow-produced hay for winter feed.

This progress report deals only with the gains made by animals on irrigated pasture during June, July, August and September, 1954. An irrigated meadow of about 11 acres was subdivided into 8 fields, 4 of approximately 0.9 acre each, and 4 of about 1.9 acres each. The four 0.9 acre fields were fertilized with 100 pounds of N per acre in mid-May and again with the same amount on July 22. This meadow had been leveled, prepared for border irrigation and seeded to a mixture of brome, orchard and meadow fescue grasses and alsike clover in the fall of 1952. It was used as irrigated pasture during the summer of 1953.

The soil had been disturbed in the clearing and leveling operations in 1951 and 1952 but generally has a shallow cover of medium textured soil containing gravel and cobble stones. The sub-stratum is the characteristic sand-gravel-cobble that underlies most mountain meadows. The depth to the sub-stratum varies from 0 to 10 inches.

In preparation for this experiment the length of run was cut to a maximum of about 400'. Irrigation practices were flood irrigation of two 25' wide borders at a time using as large a head as was available. Normally, the water was applied for 45 minutes to 75 minutes, depending somewhat on the variability of the intake rate which was influenced by the thickness of the soil mantle.

On the 3rd of June, 24 yearling heifers averaging 576 pounds were placed on this irrigated pasture and divided--12 to the fertilized fields and 12 to the no-treatment fields. Grazing management was on a rotation basis through the four fields of each fertility level. During the 103-day period June 3 to September 14, five complete rotations through four

fields were provided. The heifers were weighed at the completion of each rotation. For the 103-day grazing period gains on the no-treatment area averaged 272 pounds per acre. Gains on the nitrogen fertilized field averaged 493 pounds per acre.

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Nebraska. To determine what effect chlorosis may have on yield of field beans in North Platte Valley and what treatment would reduce the chlorosis. R. R. Allmaras, Soil Scientist, Scotts Bluff.

Ferrous Sulfate Relieves Field Bean Chlorosis

Field beans grown on calcareous soils (Minatare and Mitchell soil series) may at some time during the growing season show chlorosis. There is a great range of severity of chlorosis until the beans reach bloom stage. In the later stages the chlorosis is not as apparent. The incidence of this chlorosis may be brought about by rainy or cool weather and by irrigation.

Several years of experimental evidence indicates that the field beans in this area will not respond favorably to nitrogen fertilizer applications either vegetatively or in yield of beans. An application of 1% ferrous sulfate solution will cause the chlorotic leaves to become green. However, to continuously alleviate chlorosis, applications of ferrous sulfate must be made frequently. It is the opinion of the observer that repeated applications of ferrous sulfate sprays will increase yield. Observations have shown a tendency for ferrous sulfate sprays to be relatively ineffective in alleviating the chlorotic condition of the plant after the plant has reached bloom stage.

A spring application of 30 pounds of ferrous sulfate plus 25 pounds Na Fe (EDTA) did not have any influence on the chlorosis of the plant.

Foliar applications of 1% zinc sulfate and 2% manganese sulfate did not alleviate but in fact aggravated the condition.

Field observations also indicate that field beans following sugar beets in the rotation are more chlorotic than when they follow other crops in the rotation.

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New Mexico. To determine alfalfa, cotton, and sorghum fertilizer needs. Ross W. Leamer, State College.

Alfalfa Response to Phosphate Varies Widely

Rates of phosphorus fertilization were the main variables used in the alfalfa trials. Potash was applied to some of the more sandy soils. Most of the fertilizer applications were broadcast on the surface of established stands.

Data from two years show that alfalfa has responded to phosphate fertilization in the lower Pecos Valley, in Lea County, the Estancia Valley, and in the Tucumcari Irrigation Project. When the fertilizer is applied at one time, the rate should be heavy enough to supply about 60 pounds P_2O_5 per acre per year the alfalfa is to be harvested for hay. The actual rate chosen will depend somewhat on the previous fertilizer and cropping history of the field and the amount of irrigation water available.

Results from the Deming area and the Gila River valley indicate that the major soils contain ample amounts of phosphorus for current production. How long this supply will last is not known but no increases have been obtained from applications of phosphorus in the two years these trials have been conducted.

The mountain valleys in northern New Mexico appear to need less phosphate than some of the other sections. The shortage of irrigation water in some of these areas in 1953 limited the yields so that no adequate measure of the fertilizer requirements could be obtained.

Well Watered Cotton Needs Nitrogen--Phosphorus Fertilizers

Average cotton yield differences due to fertilizer were smaller in the Pecos Valley than the other areas represented. This is probably because of the limited amount of irrigation water available in 1953 and the fact that two of the trials were on areas which had been in alfalfa and fertilized before these studies were made.

Both nitrogen and phosphorus are needed in the rotation when adequate irrigation water is available. The areas tested in Lea County had been farmed only a short time and responded to both nitrogen and phosphorus. Neither phosphorus nor nitrogen alone gave as marked yield increases as when they were applied in combination.

Yields increased to relatively heavy applications where water did not limit growth. At Deming no advantage can be seen from adding phosphorus although significant increases were obtained from nitrogen applications.

Grain Sorghum Responds to Nitrogen at 3 Locations

Nitrogen gave increases in yield at all three locations studied, with 60 pounds of N being as good as the heavier rate. The response to phosphorus was varied. No response was obtained at Estancia but a marked increase was noted at Lovington in 1952. In 1953 the trial at Lovington gave an increase from phosphorus only at the highest rate of nitrogen. The difference between the two trials at Lovington is probably due to the fact that the one in 1952 was on land that had grown two crops of sorghum and one of cotton whereas the 1953 trial was on land which had been in grass prior to 1953. Potash gave no increase in yield wherever it was used.

A study of the number of heads harvested from the various plots shows that the increases in yield result from more grain per head rather than a larger number of heads. Fertilizers did not cause a difference in the bushel weight of the grain in any of the trials.

West

California. Effect of soil moisture and nitrogen on yield of sugar beets. K. R. Stockinger and B. A. Krantz, Southwestern Irrigation Field Station, Brawley.

Moisture, Nitrogen Increase Beet and Sugar Yields

An experiment was carried out in 1953-1954 in which the effects of six soil moisture regimes and four levels of nitrogen fertilizer application on yield of beets and sugar were studied. The soil moisture levels were controlled by irrigating whenever tensiometers of gypsum blocks installed in the plots indicated it was necessary. The nitrogen was side-dressed on the beets at planting, at thinning, and when it started to warm up in January. The beets were planted on October 1 and harvested in early July. The test was set up as 6 x 4 factorial, replicated four times.

The description of the treatments and the results are given in Tables 1 and 2. The results in Table 1 show that as the soil moisture is maintained at a higher level, yields increased up to treatment M 2. The additional moisture available in M 1 did not give any increase in yield but it also did not depress the yield or sugar percentage. The yields of sugar are directly related to the number of irrigations but level off after seventeen irrigations.

Nitrogen fertilizer increased yield of sugar by more than a ton per acre. The yield of both beets and sugar responded with good increases at all rates of nitrogen, even at the 320 pounds of nitrogen per acre. There was slight depression in the sugar percentage at the high nitrogen rate but the differences were not significant.

There was no significant interaction between nitrogen and moisture. The yield increases due to the different rates of nitrogen were similar at all levels of nitrogen. The top yield was 4.48 tons of sugar and 30.7 tons of beets with 320 pounds of nitrogen per acre and seventeen irrigations.

TABLE 1.--Per acre yields of sugar and beets and sugar percentage under various soil moisture conditions

Treatment No.	Tension prior to irrigation at 8-in. depth	Irrigations	Sugar	Beets	Sugar
	Atmospheres	*Numbers*	*Percent*	*Tons*	*Tons*
M 1	.3	22	15.2	25.0	3.86
M 2	.7	17	15.2	25.9	3.89
M 3	2.0	12	14.6	24.3	3.55
M 4	6.0	10	14.5	23.2	3.32
M 5	.7 to May 1 then like M 3	15	15.0	25.0	3.76
M 6	.7 to April 1 then like M 3	14	14.6	25.5	3.69

TABLE 2.--Per acre yields of sugar and beets and percent sugar at various rates of nitrogen

Nitrogen applied per acre	Sugar	Beets	Sugar
Pounds	*Percent*	*Tons*	*Tons*
0	14.8	20.8	3.08
80	15.2	24.1	3.62
160	14.9	26.1	3.88
320	14.4	28.2	4.13

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Oregon. A survey of P and K content of the soils and of alfalfa in Malheur County, Ore. Albert S. Hunter, Corvallis.

Malheur County Soils have adequate K, few deficient in P

Three years of extensive soil fertility research on a large number of farms on the Owyhee and Vale Projects have been completed. Data secured to date indicate that few soils in these projects are deficient in P and that all experimental sites used are adequately supplied with K. These experimental sites were not selected at random over the whole of these projects. The validity of these conclusions was tested the past year by a survey of approximately 150 fields selected at random from 2800 80-acre tracts on the two projects, using alfalfa as the test crop. Samples of the first alfalfa cutting were composited from five quadrats of each field tested and analyzed for P and K. Soil samples were secured from these same quadrats, by 8-inch increments to 24-inch depth, and analyzed for P and K. pH determinations were also made.

Alfalfa yields on these farms were generally satisfactory since the first cutting yields measured more than 2.2 tons per acre on 82 percent of the farms. A few low-yielding sites show low P content of both the alfalfa and soil samples.

An analysis of the survey data (yet incomplete) indicates the conclusions drawn from the soil fertility tests are confirmed. Only relatively few of the soils of Malheur County are presently deficient in P, although many may be near the deficiency level. Farmers should be encouraged to have occasional tests made of their soil, and where low values of P are found they should apply at least maintenance amounts of this fertilizer element. The conclusion that K is adequate in Malheur County soils is substantiated. The soil analyses data show the pH of the upper 16 inches of soil is within the favorable range of 6.8-8.2.

* * * * *

Oregon. Fertility studies with wheat in the Columbia Basin. Albert S. Hunter, Corvallis.

Either Fall--or Spring-Applied N Increases Wheat Yields in Columbia Basin

A preliminary analysis of data from fertilizer experiments located on 48 widely selected farms of the Columbia Basin counties of Oregon was initiated in the fall of 1953. Nitrogen was applied in the fall and spring from different sources, alone and in combination with P and S.

Yield data obtained from the 48 experiments harvested indicate that:

1. Significant yield increases were obtained from fall-applied N in 36 of the 48 experiments on winter wheat. The effects were nonsignificant on 8 farms, while on 5 farms fall-applied N significantly decreased yields. On these last farms the soils were generally shallow.
2. Significant yield increases from spring-applied N were obtained on 42 of 48 farms. No significant yield decreases were observed.
3. Fall-applied N gave significantly higher yields than spring-applied N on 15 farms. Spring-applied N was superior on 12 farms. On 21 farms the differences, due to the time of application, were not significant.
4. Increased yields due to the application of P did not appear significant.
5. A significant response to S was obtained only in the case of recropping with spring wheat on one farm.

* * * * *

Oregon. (a) Fertilization of spring wheat under irrigation (b) Fertilization of field beans on sandy soil under irrigation. Carl A. Larson and James A. Burr, Umatilla Field Station, Hermiston.

High Rates of N with Phosphorus Benefit Spring Wheat

The data presented in the following table show that highly significant increases in the yield of spring wheat resulted from all fertilizer treatments under the rather unfavorable climatic conditions which prevailed during the early part of the 1954 growing season at the Umatilla Field Station.

*Spring wheat: Yields per acre associated with various fertilizer treatments in 1954

Treatment	Yield Bushels
Check	9.1
60 N	23.8
120 N	27.3
180 N	25.7
180 N + 100 P	40.8
90 N + 90 N + 100 P	42.2
Manure 15 T/A	27.1
Alfalfa 3 T/A	27.0
L.S.D .05	7.32
.01	9.85

*Notes: Seeding date March 4. Five irrigations were applied to the plots.

The greatest yield increases were associated with the application of phosphorus fertilizer with high rates of nitrogen fertilizer. Split applications of the high nitrogen rate with phosphorus fertilizer did not appear advantageous under the conditions prevailing this year.

Fertilizers Fail to Increase Field Bean Yields

No significant effects on the yield of Red Mexican field beans resulted in 1954 from applications of 100 pounds of N, 200 pounds of N, 150 pounds of N plus 100 pounds of P, or 150 pounds of N plus 5 pounds of Zn per acre.

The dry weight of the bean plants and the zinc uptake of the plants were variously increased by the treatments, being greatest where zinc was applied.

SOIL STRUCTURE

Southeast

Mississippi. To determine influence of deep-rooted legumes on soil root zone. H. V. Jordan, State College.

Kudzu improves Soil and Encourages Deeper Rooting of Corn

Will a deep-rooted legume improve the soil and encourage deeper rooting of the following crops? A partial answer is given by a study with kudzu and corn at the North Mississippi Branch Station on a soil with a genetic pan.

Kudzu was grown continuously for four years on one series of plots and corn was grown continuously on another. Then, in the fifth year, the soil was subjected to physical and chemical analysis, the entire area planted to corn, and the depth of rooting and yields of the corn determined. Following this, corn was grown uniformly over the entire area for another three years and yields taken.

Here are the results:

Corn rooted deeper on the land following kudzu than it did following corn. Roots from corn following the 4 years of kudzu were present throughout a 4 foot profile. Following 4

years of continuous corn, corn roots were limited largely to the first foot although there was some penetration into the second and third feet.

Measurable soil physical properties of the land under kudzu was improved, but only in the plowlayer. Bulk densities were lower and the total pore spaces and degrees of aggregation were increased.

On the chemical side, the kudzu soil was higher in nitrogen, organic carbon, and exchangeable potassium especially in the surface foot. These were also higher in the second and third foot depths, although the differences were much smaller.

Even with ample fertilizer, yields of corn following the kudzu were much higher than those following the continuous corn. The yield advantage from kudzu was still persisting in the fourth year of the measuring crop.

Nitrogen fertilizer response was very large on corn following continuous corn, and modest on the corn following kudzu. On the first succeeding corn crop, the kudzu appeared as effective in supplying nitrogen as 160 pounds of nitrogen per acre applied to continuous corn. With each succeeding corn crop, the nitrogen benefits from the kudzu lessen.

Results from this study, therefore, indicated marked and long-lasting advantages from the kudzu. It must be pointed out, however, that all of the differences noted cannot be entirely ascribed to the kudzu. Growing continuous corn during the initial four years undoubtedly had a deleterious effect on the soil.

Great Plains

South Dakota. Use of soil additives to control crusting and increase emergence of sugar beet seedlings. Bruce L. Baird, Newell.

Weather Determines Effect of Soil Conditioners on Seedling Emergence

In 1952 and 1953 during favorable weather conditions for emergence there appeared to be little or no advantage in the use of soil additives. Under adverse weather conditions, the emergence has been increased as much as 50 percent.

In some of the 11 trials conducted in 1954, it was possible to observe the effect of the additive on the soil surface but there was no increase in emergence attributed to additive treatment.

DRAINAGE

Southeast

North Carolina. Effect of drainage on water table levels and yields at Plymouth. W. V. Chandler and Ellis G. Diseker, Raleigh.

Title Drains Increase Yields at Plymouth, N. C.

An experiment was started on a Weston silt loam in 1950 to study the effect of varying degrees of drainage on (a) the depth of water tables following rains, and (b) crop yields. Four degrees of drainage were established consisting of poor drainage (control of surface water only) and tile at depths of 2, 3, and 4 feet. (The poorly drained plot is fairly typical of the average drainage practices in the tidewater area of this state.) Tile are spaced 160 feet apart at each depth. The poorly drained area is 310 feet wide with shallow ditches on three sides to control surface waters and tile at 2-foot depth on the fourth side. Adequate border is provided so that these ditches and tile have no drainage effects upon the experimental area.

Observation 24 hours after each of 18 rains in 1953 showed the water table to be lower than 1 foot from the surface on the plots where tile was 3 and 4 feet deep except following 2 rains of 3.65 and 6.78 inches. On 8 occasions the water table ranged from 0.2

to 0.9 foot below the surface on the 2-foot depth tile plot. There were only 5 occasions when the water table was as deep as 1 foot below the surface on the poorly drained or check plot. There were 4 times when the water table was at the surface or 0.2 foot above the surface 24 hours after the rains on this plot.

The corn yields are shown in the following table:

Corn yields per acre associated with different degrees of drainage, Plymouth, N. C.

	1951	1952	1953	Average
	Bushels	*Bushels*	*Bushels*	*Bushels*
4-foot depth tile	95.2	66.9	55.6	72.6
3-foot depth tile	88.1	63.8	56.2	69.4
2-foot depth tile	86.0	63.9	61.1	70.3
Poorly drained-check	64.7	4.4	25.5	31.5

Yields have decreased each year partially due to poorer climatic conditions. The decreased yields on the check plot are due in part to the failure to obtain and maintain stands. On the basis of the 3-year data, there are essentially no differences in yield on the 2-, 3-, and 4-foot depth tile plots although water table levels were higher on the 2-foot depth tile plot than on the 3- or 4-foot depth tile plots. There are indications that in drier years tile placed deeper than 2 feet may give excessive drainage as evidenced by the 1953 yield data. The check plot is too poorly drained to produce optimum yields.

Great Plains

Colorado. Model study to investigate problems relative to installation of a tile interceptor drain. Jack Keller, Irrigation Engineer, and A. R. Robinson, Civil Engineer (Irrigation), Ft. Collins.

Where Place Interceptor Drain? How Will it Affect Water Table?

The problems for study: (1) What is the shape of the upstream draw-down curve of the water table after the tile drain has been installed, and at what distance does this curve become asymptotic to the post-installation water table? (2) How deep should the interceptor drain be placed? Should the tile be placed on an impervious layer, above this layer, or half way between the layer and the water table?

At the present time this project is in the planning stage. Arrangements have been made to use the large, tilting flume which is available in the hydraulic laboratory. This flume is 70 feet long and is equipped with jacks so that a wide range of slopes can be modified to accommodate a 3- to 4-foot depth of sand at a width of from 2 to 4 feet. Drain tile will be placed at different levels near the lower end of the flume. With this arrangement it will be possible to construct a 2:1 scale ratio model of an actual tile, interceptor drain.

East

Maryland. Cover crops for tobacco land. Clarence S. Britt, Beltsville.

Late-Turned Grass-Vetch Cover Crops Best for Continuously Grown Tobacco

The type of winter cover crop greatly affects the yield and market value of tobacco. This is strikingly shown in a 6-year study conducted at Beltsville on land used for tobacco growing each year.

Tobacco yield, market price, and per acre value of tobacco associated with cover crops, average for 6-year period

Cover	Yield per acre	Price per pound	Value per acre
	Pounds	*Cents*	*Dollars*
None	906	51.7	468
Ryegrass	993	52.2	518
Vetch	1,330	48.1	640
Ryegrass-vetch	1,389	54.6	758

Note that the ryegrass-vetch mixture produced the highest yield, quality (as measured by price per pound), and total per acre value. Rye-vetch and wheat-vetch mixtures, not shown in the table, produced about equally as well. The mixtures improved the water stability of the soil aggregates.

Ryegrass cover improved the yield, quality, and acre value over no cover but to a considerably less extent than did the mixtures. The ryegrass gave marked improvement in water stability of the soil aggregates, but nitrogen deficiency symptoms were observed on the tobacco crop during some seasons.

Vetch alone increased tobacco yields considerably but the tobacco was of poorer quality. The tobacco following vetch was often too green and the plants did not ripen uniformly. The vetch gave practically no improvement in water stability of the soil aggregates.

During the six-year study, the cover crops were turned at two different dates, approximately April 10 and May 10. The May turning increased the top growth of the cover crops by 300 to 400 percent. Tobacco yields and quality following ryegrass were not affected to any extent by turning dates. Yields following vetch were substantially increased by late turning, but the quality of the crop was materially reduced. The yield of tobacco following the late-turned mixtures of vetch and non-legumes was also substantially increased and the quality was not adversely affected.

Late turning of the cover crops increased water stability of the soil over early turning. The highest water stability associated with late turning resulted from the vetch-ryegrass mixture.

Texas. Management of blackland soils with beef cattle. R. M. Smith, Blackland Experiment Station, Temple.

Pasture, Grain, Hay in Texas Blackland Give Good Returns in Beef

A return of $26 per acre for crops completely grazed has been realized for the period August 1953-September 1954 although the first nine months of 1954 was the driest January-September period on record (total rainfall, 10.19 inches).

Rainfall of approximately 8 inches in late October 1953 was a help, but the system of grazing developed through the years at Temple is the primary reason for the favorable results. This system involves fitting the different kinds of grazing together to provide for continuous cattle gain and care to avoid excessive or untimely use of grass to the detriment of crop yields or the soil.

Beef Cattle Financial Summary, 1953-1954

	Average per head or acre
100 head cattle: Steers at $21 and Heifers at $19 per cwt., purchased August 13, 1953	$80.00
Acres completely grazed per head--1.33	
Acres partially grazed per head--1.12	
Total cost of cattle plus winter feed, per head	87.50
Value of 746 pound cattle after grazing at $16.50 per cwt	123.00
Return for grazing* per head	35.00
Return for grazing* per acre completely grazed	26.00
Feed cost per head in feed lot	35.00
Cost of cattle and feed to September 23, 1954	157.50
Estimated net sale price per head on September 23, 1954	225.00
Net return in feed lot*	67.50
Overall estimated net return per head	101.00

*These figures do not include labor, interest on investment, veterinarian bills or other minor miscellaneous items but represents returns above feed and original cost of cattle. The loss by death of one heifer is deducted.

The estimated feedlot return of $67 per head (sale prices estimated by beef cattle experts) emphasized that farmers can convert their grain and hay into beef at a profit in the Blackland under present market conditions for beef and for grain crops.

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Texas. Soil management practices for corn production--irrigation, fertilizer, spacing. R. P. Bates, Temple.

Corn Requirements at Texas Locations Found to Vary Greatly

Corn production work of the Blackland Station in 1954 includes: (1) a supplemental irrigation test on the station in which irrigation, cropping system, nitrogen application, and plant population were varied; (2) a fertilizer test under irrigation in the Little River bottom; (3) fertilizer tests on soils of low, medium, and high lime content near Thrall, Texas; (4) fertilizer tests following cotton, oats with sweetclover, and fescue; and (5) spacing tests following cotton, oats with sweetclover, and fescue.

Irrigation helps. In 1954 corn following sweetclover continued to outyield corn following corn. The largest yields have been obtained from plots where corn followed sweetclover and received irrigation but not nitrogen. In almost every case following sweetclover, 90 pounds of nitrogen per acre has slightly reduced corn yields. In almost every case following corn, nitrogen fertilizer has increased yields, especially where water was applied. Supplemental irrigation has greatly increased yields, especially following sweetclover, and where nitrogen was applied following corn. In general, 12,000 plants per acre have outyielded 6,000 plants per acre. In 1953, however, the reverse was true on plots receiving no irrigation. In 1954 on plots receiving no nitrogen after corn the thin population outyielded the thick population.

Irrigated corn in Little River Bottom responds to nitrogen. --In 1953 corn yields under irrigation in the Little River bottom showed very little response to the application of fertilizers. In 1954, however, a tremendous response to nitrogen fertilizer was shown. Ninety pounds of nitrogen per acre more than doubled corn yields, while 180 pounds of nitrogen increased the yield significantly over the 90 pound rate. Neither phosphate nor potash significantly affected corn yields.

Fertilizers are needed for optimum corn yields in tests near Thrall. --Tests on three different sites near Thrall, Texas, with low-lime, medium-lime, and high-lime soils show that during the last two years phosphorus has consistently increased corn yields. In 1954 the addition of nitrogen with phosphorus on the low- and medium-lime soils significantly increased corn yields over phosphorus alone. Thirty pounds of nitrogen and phosphorus appear to be adequate in most cases; however, in 1954 the 60-pound rates did tend to out-yield the 30-pound rates.

Fertilizers bring little response on station farm. --On the station farm very little response of corn yields to nitrogen and phosphorus has been obtained in tests following cotton, oats with sweetclover and fescue. In 1953 nitrogen actually decreased yields following cotton and following oats with sweetclover. In 1954 phosphorus significantly increased yields following cotton, especially when applied in combination with nitrogen.

Row systems and spacings make little difference in 1954. --In an effort to determine whether corn yields could be increased by leaving vacant one row out of three and by reducing the plant population, tests were conducted in 1953 and 1954 following different crops. In 1953 the 12-inch spacing in two-thirds of the rows outyielded either the 18-, 24-, or 36-inch spacing in every row. In 1954 very little difference was obtained from row systems and spacings.

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Texas. Cotton and grain sorghum fertilizer response. E. D. Cook, Temple.

Small Increases in Yields of Cotton and Sorghum Due to Fertilizers

A summary of fertilizer results with cotton at three off-station locations indicates that all differences related to treatment tend to be small. Moderate rates of phosphorus and nitrogen in combination tend to give the highest yields. Experiments on the station throughout a number of years have failed to show significant responses of cotton to any fertilizer combination.

Off-station studies of grain sorghum responses to fertilizer, carried out at two locations, show that combinations of phosphorus and nitrogen have given the most favorable results. Nitrogen alone brought some yield reductions. It should be remembered that no years with rainfall above normal are represented by these data.

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Wyoming. Introduced grass and legume mixture for dryland hay production and fall grazing. Archer Substation, Cheyenne. Frank Rauzi, Laramie.

Stiffhair Wheatgrass-Alfalfa Mixture Superior to Russian Wildrye-Alfalfa Mixture

Pastures were seeded in the spring of 1950 and cut for hay in late June, 1951. Regrowth was grazed beginning October 1. This same procedure will be continued. A native pasture was used for check to compare average gain per head and average gain per acre with the seeded pastures. The 3-year average hay yields ranged from 396 pounds per acre on the Russian wildrye-and-alfalfa mixture to 793 pounds per acre on the stiffhair wheatgrass-alfalfa mixture. The hay yields on the Russian wildrye-and-alfalfa mixture represents mostly alfalfa due to low growth habit of the Russian wildrye.

No hay was obtained in 1954 because of drought. The sheep were turned on pasture October 1. The outlook is for fewer sheep days of grazing this fall.

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West

Washington. Effects of cropping systems and nitrogen fertilization on wheat yields. Glenn M. Horner, Pullman.

Green Manures Influence Wheat Yields

Several cropping systems were established in 1936 on soil that was severely depleted. The topsoil of the plots is about 8 inches deep, and the slope has a gradient of 30 percent.

Average wheat yields per acre from five rotations, 1952-54

Crop rotation	Crop	Wheat yields 1952-54
		Bushels
Alfalfa & grass (4 yrs.)--wheat--wheat.....	Wheat after alfalfa	40.9
--peas--wheat.....	Wheat after wheat	33.9
	Wheat after peas	33.9
Sw. clover & grass--gr. manure.....	Wheat after sweetclover	39.1
--wheat--peas--wheat.....	Wheat after peas	32.9
Alfalfa & grass--gr. manure.....	Wheat after alfalfa	37.0
--wheat--peas--wheat.....	Wheat after peas	36.7
Wheat--peas.....	Wheat after peas	27.0
Wheat--summer fallow.....	Wheat after fallow	23.9

Cropping systems that included alfalfa and sweetclover resulted in higher wheat yields than cropping systems without legumes, not only for the first crop following the legume, but also for each wheat crop of the rotation. Under such depleted soil conditions, the summer fallow practice released but a relatively small amount of nitrogen, as indicated by the low yield of 23.9 bushels.

Sweetclover-Grass Green Manure Better than 70 Pounds per Acre of Nitrogen

The first year's results from the new set of plots designed to compare sweetclover and fertilizer as sources of nitrogen are summarized below.

Wheat yields per acre associated with previous crop and with nitrogen fertilizer, 1954

1953 crop	Nitrogen applied per acre*	Wheat per acre
	Pounds	*Bushels*
Winter wheat.....	none	24.0
Peas.....	none	41.9
Peas.....	70	51.5
Sweetclover and grass.....	none	76.5

*Ammonium sulfate applied (broadcast) after seeding wheat in the fall of 1953.

Sweetclover handled as a green manure crop was much more effective for wheat production than an application of 70 pounds of nitrogen as ammonium sulfate on pea land.

RESIDUE MANAGEMENT

Great Plains

Nebraska. Conservation practices on sandy land--Pierce, Nebraska. F. L. Duley, Lincoln.

Nitrogen Might Make Oats Profitable on Sandy Land

On the sandy land at Pierce, oats have usually been a rather unsatisfactory crop. In fact, many farmers have quit growing oats because of the frequent low yields and low value of the crop. The main reason for low yield seems to be a shortage in the nitrogen supply. Since oats make their principal growth over a short period, they require large amounts of available nitrogen in a rather short interval of time. This sandy soil is not capable of delivering nitrate in large amounts during any short period. Hence, the use of nitrogen fertilizers has a distinct possibility for increasing yields, as shown in the following table. The results were obtained in the corn, oats, rye and partridge pea rotation and illustrate the effects of nitrogen fertilizer.

Oats yields and returns as affected by different amounts of fertilizers, 1954, Pierce, Nebraska

Fertilizer used	Yield per acre	Increase from fertilizer	Increase from extra nitrogen	Value of increase[c]	Return per lb. N.
	Bushels	*Bushels*	*Bushels*	*Dollars*	*Cents*
None	13.1	--	--	--	--
8-32-0 at planting[a]	12.2	-0.9	--	--	--
8-32-0 plus 33# N[b]	28.8	15.7	16.6	11.62	35.2
8-32-0 plus 66# N	40.6	27.5	28.4	19.88	30.1

[a] Applied in row with seed at 100 lbs. per acre.
[b] Nitrogen applied a few days after oats were up.
[c] Oats at 70 cents a bushel.

The rotation of corn, oats, rye and partridge pea is not proving out very well. Partridge peas must be seeded each year in the rye in order to insure a good stand. With the system the partridge pea seed must lie in the ground for two years. While some germination of peas is obtained after this length of time, there usually will not be a good stand. The use of vetch with rye, on the other hand, is more profitable under present conditions and a greater yield increase will result on the following corn crop.

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Nebraska. Soil microorganism and soil structure. T. M. McCalla, Lincoln.

Fungi Differ in Abilities to Aggregate Loess

Twelve cellulose-decomposing fungi were found to have differing abilities to promote aggregation of Peorian loess (ground wheat straw, 1% concentration, was the source of energy material). It is evident that Stachybotrys atra was the most effective aggregator. The aggregation brought about by S. atra ranged from approximately 2 to 30 times that effected by other fungi. The data also indicate that for some of the cultures there was considerable difference between the extent of aggregation produced after 4 weeks by incubation.

Further studies with S. atra were designed to furnish information relative to the environmental conditions under which this organism is most effective in aggregation of Peorian loess. After one week of incubation a relatively high degree of aggregation was obtained. The effect of incubation temperature shows that essentially equivalent aggregation was attained at 20°, 24°, and 28° C. Moisture levels of 10 and 15% are suboptimal; change within the range of 20 to 30% was without effect. With an increase in concentration of energy material, there tends to be an increase in aggregation. Alfalfa was superior to straw in the promotion of aggregation by S. atra.

These results show that a great deal can be done to change the aggregation of Peorian loess through selection of the proper microorganisms. In addition, when a given microorganism is selected, it is possible to influence the degree to which that microorganism will aggregate the soil by controlling moisture, carbon source and concentration, and time of incubation. The results also show that many soil microorganisms which decompose high cellulose residues do it without contributing a great deal to soil aggregation.

Oregon. Columbia Basin erosion control. T. R. Horning, Agricultural Engineer, Pendleton Branch Experiment Station.

Stubble Beaters for Reduction of Heavy Stubble Tested

Several types of stubble beaters or "busters", used for the reduction of heavy wheat stubble, have been tested at the Pendleton Station. This operation is coming into more general use in areas having 15 inches and more of annual rainfall on good soils. Amounts of stubble greater than 3000 pounds per acre generally interfere with the subsequent operation of most older type plows and drills.

The revolving knife-type buster, used on 6000 to 8000 pounds per acre stubble, reduced the standing stubble but did not handle the lodged or combine scattered straw. It was next to impossible to plow this field following the use of this beater.

A rotary type, with arm or chain beaters, picked up most of the down straw and mulched both it and the standing stubble into short lengths so that subsequent plowing was accomplished with little difficulty.

Both these beaters were 8 feet wide and have the disadvantage of high power requirements and of a cost approximating $100 per foot of effective width.

A new 14-foot, center-hinged rotary type beater was tested this year. The power requirement per unit of width of this beater is reduced due to the use of shorter, lighter beater arms. The beaters rotate in a forward direction, thereby exerting a forward thrust to the machine as they engage the stubble and straw near the ground surface. The cost of the machine is reduced to about $80 per foot of width.

This new machine under test did a satisfactory job of stubble reduction on 6000 pounds per acre wheat stubble, as well as with 36-inch sweetclover and with seed plot residue of intermediate wheat grass.

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Idaho. Crop residue utilization and erosion studies in dry farm areas of Southern Idaho, Tetonia Branch Experiment Station. F. H. Siddoway, St. Anthony.

Standing Stubble Increases Yield of Winter Wheat

The effect of three methods of stubble management, initiated in the fall of 1952, was measured by the yield of winter wheat planted in the fall of 1953 and harvested in 1954.

The three treatments used were as follows: (1) eight inches of stubble was left standing; (2) the stubble was cut and removed; and (3) the stubble was burned. All fields were summer fallowed in 1953. Moldboard and subsurface methods of plowing were also compared.

Yield of winter wheat from the plots where stubble was left standing exceeded that from the plots where stubble was cut and removed and that from the plots where stubble was burned by 4.7 and 9.2 bushels per acre, respectively. There was also a marked and parallel difference in the vegetative growth of the wheat of the order of 26, 20, and 15 inches mature height for the three residue management treatments. Subsurface tillage depressed yields somewhat but not significantly. The yield data are summarized in the following table:

Wheat yields per acre from 3 stubble residue treatments and 2 methods of plowing

Method of plowing	Stubble left standing	Stubble cut and removed	Stubble burned	Average
	Bushels	*Bushels*	*Bushels*	*Bushels*
Moldboard.....	26.4	21.1	17.1	21.5
Subsurface.....	23.8	19.7	14.7	19.4
Average.....	25.1	20.4	15.9	20.5

Least Significant Difference for residue treatments
.05 = 2.4 bushels
.01 = 3.5 bushels
All other differences nonsignificant

Both 1952 and 1953 winter periods had below normal precipitation, but the plots had an equal chance to intercept moisture during the winter of 1953. Yield differences, therefore, are attributable to the soil moisture intake during the winter of 1952 as influenced by the residue treatments. Standing stubble served to trap and hold winter snowfall against windsweep. The stubble-burned plots were swept bare of snow most of the winter. The wheat on the stubble-burned plots showed soil moisture stress considerably before crop maturity and earlier than on the other plots.

These yield relationships suggest the advantage of leaving stubble undisturbed during the winter following harvest, particularly during periods of below normal precipitation, for the dry land wheat areas of Southern Idaho.

TILLAGE AND CULTURAL PRACTICES

Northeast

New Jersey. Value of cultivation. G. D. Brill, New Brunswick.

Cultivation has Benefits Other Than Weed Control

Can corn cultivation be eliminated if weed control is otherwise achieved? To investigate this question, two runoff plots were established in 1948 on a loamy sand at Marlboro. Corn was planted on both plots. On one the corn was cultivated two or three times to control weeds. On the other, a 2,4-D pre-emergence spray was applied the first year. This failed to control the grasses, so weeds were singed off with a torch two or three times each season. Soil and water losses were measured from time of planting until the corn was harvested. Both plots were planted alike and received 1000 pounds of 5-10-10 fertilizer per acre. Half of the fertilizer was plowed under and half was disked in. For the first three years the rows were planted with the slope and for the second three, across the slope. Measurements of total soil and water losses and corn yields were made on each plot and are summarized in the table.

Water run-off, soil loss per acre, and corn yields per acre from cultivated and uncultivated* plots at Marlboro, N.J., 1949-50 and 1951-53

Periods	Cultivated			Uncultivated		
	Runoff	Soil loss	Corn yields	Runoff	Soil loss	Corn yields
	Inches	*Tons*	*Bushels*	*Inches*	*Tons*	*Bushels*
1949-1950 (rows up and down hill)...			80			63
During cultivation.....	1.35	1.75		2.29	2.19	
After cultivation.....	6.72	4.23		6.77	3.68	
1951-53 (rows on contour).....			85			79
During cultivation.....	.45	1.28		1.13	1.74	
After cultivation.....	.21	.12		4.58	3.20	

*Weeds controlled otherwise on uncultivated plot

The data indicate that cultivation is of value other than for the control of weeds. In all instances, yields were higher on the cultivated plots. Lower yields on the uncultivated may have resulted from a lack of nitrogen since unexplained nitrogen deficiency symptoms were frequently observed on the uncultivated corn. During the cultivation period, runoff and soil losses both on the up-and-down and the contour were materially reduced on the cultivated plot. After cultivation ceased, runoff and soil losses from the cultivated plot of the contoured corn remained considerably lower than from the uncultivated. However, the cultivation effect did not carry over in the corn planted up and down hill.

In evaluating these results, the reader must remember that only two plots were used and one soil investigated.

Midwest

Wisconsin. Legume intercropping in corn. Orville E. Hays, LaCrosse.

Seeding Legumes in Corn May Offer Promise on Fayette Soils

Extremely high soil and water losses in spring grain following corn have pointed up the need for an expanded research program on seeding legumes and grasses in corn. With the development of band seeding, it is apparent that a successful stand of legumes can be obtained, even in a relatively dry fall.

In 1953 alfalfa was band seeded and broadcast on July 10 with a one horse grain drill in corn rows of 40-inch, skip row (average 60 inches), and 80-inch spacing. Corn yields were 97, 86, and 76 bushels per acre, respectively. Stand counts taken on September 4 showed satisfactory stands on all treatments. However, legumes that were band seeded were taller and showed more vigor than those that were broadcast seeded.

Precipitation for 1953 was normal until July, when 11.15 inches were recorded, better than 7 inches over normal for the month. For the period August 15 to November 19, the soil was very dry - no rain occurred during this period with more than 0.30" total. Stand counts were made on April 29, 1954, to determine winter survival. The count:

Treatment	Alfalfa plants per square foot
40" row, band seeded	9.3
40" row, broadcast	5.3
Skip row, band seeded	14.0
Skip row, broadcast	8.5
80" row, band seeded	12.1
80" row, broadcast	2.6

No logical explanation is at present available for the decrease in stand on the 80" spacing. Additional years of data will determine whether this is a real difference.

In 1954 seedings were made in 40", 60", skip row, 80" corn rows on plowed land with only tractor track seedbed preparation and on normal seedbed preparation. Seedings were made with a Brillion experimental band seeder, with and without band seeding, and broadcast with a whirlwind seeder. All seedings look good at the present time. Stand counts have not been completed on 1954 seedings except on the 40" rows in one of the runoff experiments. This plot was band seeded with the Brillion seeder on July 8. Seeding rate was 10 pounds of alfalfa per acre and with 500 pounds of 0-10-30 per acre. The October count showed 8 alfalfa plants per square foot. Observation would indicate 16 or more plants per square foot on the wider row spacings.

1954 has been a wet year. During the period April to September, inclusive, 27.78" of precipitation were measured, 5.47" above the normal of 22.31 inches. So far, October has been extremely wet. This gives an excellent opportunity to compare stands and survivals in a dry fall, 1953, and a wet fall, 1954.

Machinery problems are showing up this fall. Heavy machinery is rutting the soil, and, in some cases, may decrease the stand and make additional problems in hay removal next year.

Great Plains

Kansas. Study of dates for planting wheat on fallow. Paul L. Brown, Ft. Hays Branch Station, Hays.

Early-seeded Wheat Does Best in 1953-54 Test

Average yields and test weights of wheat from a date-of-planting wheat experiment, 1953-54, are as follows:

Date of planting	Sept. 5	Sept. 15	Sept. 25	Oct. 5	Oct. 15
Yield in bushels per acre....	31.5	29.4	28.6	27.5	27.0
Test weights per bushel.....	55.8	54.0	53.5	53.5	54.0

Despite extensive mosaic infection and jack rabbit damage, the early planted wheat yielded more than the later planted wheat. As far as the later dates of planting are concerned, it is an established fact that wheat planted or emerging in late October and November normally yields less than that emerging earlier.

This experiment indicates that in some years wheat may be planted with beneficial results on land well supplied with moisture at a time earlier than the fly-free date. Early planting under favorable surface moisture conditions will provide ground cover and wheat pasture.

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Wyoming. Methods of summer fallowing and continuous cropping vs. native grass. O. K. Barnes, Sheridan.

Standing Stubble Shows Up Well in Water Intake Test on Fallow

The work this year has been that of handling the fallow land for fall seeding. The fallow treatments included:

1. Chemical control of weeds with 2, 4-D and dalapon. No mechanical treatment.
2. Chemical control of weeds (as stated above) up to mid-summer; use of sweep machine as last operation before seeding.
3. Chemical control of weed growth in fall after harvest if necessary, all subsequent operations next season with sweep machine.
4. All weed control operations with sweep machine.
5. Fall plowing after harvest; sweep machine for all subsequent operations.
6. Spring plowing; sweep machine for all subsequent operations.

Some preliminary water intake measurements were made. Three of these treatments (chemical control, sweep machine and spring plowed ground) were studied as to their effect on soils ability to take up water. The work was done by Frank Rauzi, ARS, using a truck-mounted infiltrometer. Three runs were made on each treatment using a simulated rain of approximately 2.5 inches per hour.

The land where weeds were controlled with chemicals and with the stubble still standing took up 1.52 inches in a 1-hour run, as compared with 1.28 inches on plowed ground and .98 inches on the land where the sweep machine was used.

The largest differences in intake rates developed during the second 30 minutes of the 1 hour run. In this period the chemical fallow treatment took water at the rate of .95 inches per hour as compared with .44 and .38 inches per hour for plowed ground and that where only a sweep machine had been used.

The soil where the above measurements were made is described as a grayish brown silty clay loam to a depth of 15 inches and a sandy clay loam below that to a depth of 60 inches.

Dalapon and the ester of 2, 4-D were used to control plant growth in all treatments calling for chemicals. The principal weedy grasses appearing this year were Setaria, Echinochloa, Bromus and volunteer wheat. Good control of these plants was obtained with 9 pounds of dalapon per acre applied as follows: 5 pounds per acre on May 28 and a repeat spraying of 4 pounds per acre on June 13 to pick up some misses from the first application. Broadleaf weeds were controlled with 3/4 pound of 2, 4-D per acre applied May 12 and June 13 and again on August 2 for treatment 1. On the plots involving mechanical control of weeds, 4 operations in addition to plowing were necessary during the year, to maintain clean fallow ground up to seeding time.

Due to extremely dry conditions this past season seed beds were generally poor although the surface conditions on the chemically treated plots were more favorable for seeding than on land that had been plowed.

Native Sod Takes in Water Better Than Continuously Cropped Land

Some incidental comparisons of water intake rates were obtained from Rotation Plot 576 and from a small enclosure of native range near the methods-of-fallow plots.

Plot 576 was set up in the old dryland work in 1916 and was plowed out of sod at that time. Since 1916 the only operation has been to disk and seed oats every year on the disked stubble. Three runs each were made on this plot and the native range.

Plot 576 had an average intake rate of .77 inch per hour for the 1-hour run as compared with 1.30 inches on the native range. On plot 576 the breakdown of this hour-run shows an intake of 1.25 inches per hour during the first 30 minutes and .29 inches per hour for the second 30 minute period. For native range the rate was 1.41 inches per hour for the first 30 minutes and 1.20 inches per hour during the second 30 minutes. In these two situations, the soils are comparable to those of the methods-of-fallow plots where the intake measurements were made.

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Kansas. Physical properties of soils in dry land region. R. J. Hanks and F. C. Thorp, Manhattan.

Effects of Deep Tillage on Water Intake Being Checked with New Apparatus

Work was completed on an infiltrometer which is designed to measure the relation of deep tillage (chiseling) to the water intake rate of various soils. Field tests using this apparatus are now underway.

West

California. Tillage to increase soil intake of irrigation water. Sterling Davis, Berkeley.

Subsoiling Opens Soil to Penetration of Irrigation Water

Rather intensive studies of irrigation efficiency and field intake rate are in progress in Merced and Madera Counties of California. A subsurface "hard-pan" soil layer appears to restrict water movement into and through the soil on a part of one of the pasture fields being studied.

Two soil treatments were applied to this area, and subsequent water intake rates were measured with the single ring infiltrometer. Results of these tests for two seasons are presented in the following table:

Intake rates from hard-pan ring tests, Red Top irrigation investigations, 1953-1954

Treatment	1953					1954				Average
	8/17	9/14	9/24	9/30	10/26	7/21	8/5	8/20	9/15	
	Inches per hour					*Inches per hour*				*Inches per hour*
Gypsum 10 tons per acre.....	1.25	1.16	0.80	0.85	0.71	0.94	1.67	1.15	1.24	1.09
Subsoiled to 30".....	2.90	3.50	3.80	3.50	2.85	20.00	12.00	9.50	7.00	7.23
None.....	1.10	.89	.70	.70	.53	.88	1.29	1.16	.95	.91

The effect of the application of gypsum did not appear to be significant. A sustained increase in intake rate resulting from the subsoiling treatment is noted. The value of occasional subsoiling of pasture on this type of land is suggested as a means of improving irrigation water penetration.

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Oregon. Columbia Basin soil erosion research. M. M. Oveson and T. R. Horning, Pendleton.

Winter Wheat Planted in Rough Seedbed Yields Well

Greatest erosion hazard in the wheat-pea producing area is caused from seeding winter wheat in the late fall on what is termed a well-prepared seedbed. When the land is springtoothed and harrowed to make an ideal seedbed for the seeding of fall wheat, the cloddy structure is broken to the extent that it offers very little protection from erosion. For this reason, the erosion hazard is much greater where fall wheat is seeded than where the ground is left rough through the winter and seeded to spring wheat. But comparative yields between spring and winter wheat on the Crow pilot farm have been overwhelming in favor of the fall seeded wheat. This has definitely discouraged farmers from leaving their land for seeding to spring wheat.

In the fall of 1952 strips 24 feet wide were laid out across one of the fields on this pilot farm. Six strips in all were utilized in this experiment; three were cultivated in the normal way for seedbed preparation, and three were left rough with no cultivation before seeding. Elmar winter wheat was seeded in late October at 65 pounds per acre.

This experiment was repeated in the fall of 1953 using four replications of randomized plots. Elmar wheat was again seeded at the same rate on Nov. 3.

The results from this study for the two-year period were as follows:

Yields per acre of winter wheat from rough and prepared seedbed

Treatment	1953	1954	Average
	Bushels	*Bushels*	*Bushels*
Rough seedbed.....	53.0	55.8	54.4
Prepared seedbed.....	51.2	57.4	54.3

There was no significant difference in the yield of wheat on the rough seeded plots compared to the cultivated plots with the rough seeding producing slightly higher yields in 1953, and the wheat on the prepared seedbed producing slightly higher yields in 1954. The averages for the two-year period are practically identical. The stands of wheat in both years were fairly uniform but appeared slightly thinner on the rough seedbed. This, no doubt, was caused by not covering all of the wheat during the seeding operation. Much of the wheat fell between the cracks of the clods or on large clods and was not covered until the fall rains melted down the clods. However, stooling of the wheat made up for the difference in stand. At harvest time there was no noticeable difference in the amount of culms and heads on the differently tilled plots. The entire area was fertilized with 40 pounds of nitrogen per acre using anhydrous ammonia as the nitrogen carrier. The ammonia was placed at a depth of approximately 6 inches.

There was no serious erosion during either of the two winters. However, there was erosion in the general area of the pilot farm. Some water movement did occur on the smoother tilled seedbed but not on the rough seedbed area.

Because of the favorable results obtained in 1953, two farmers in the area and one in the Walla Walla, Washington, area seeded their entire fields on a rough seedbed in the fall of 1953. All three farmers obtained favorable yields in 1954. With two years of favorable results on the pilot farm from this type of seeding, several farmers have expressed interest in the method. Erosion in the area can be reduced to a minimum if fall wheat can be successfully seeded in a rough seedbed as has been demonstrated by this experiment.

SOIL AND WATER MANAGEMENT--GENERAL

Great Plains

Texas. Cotton root rot studies. (a) Association between land slope and cotton root rot incidence and cotton yields. (b) Microbial population of root rot soils. R. J. Hervey, Temple.

Cotton Root Rot Appears to Be Associated with Land Slope

In an outlying study conducted at the Blackland Watershed Station, Riesel, a number of plots (1/100 acre size) were randomly located in large cotton field areas varying in grade from level to 3 to 4 percent slope.

Average values for disease incidence and yield derived from plots in three land slope categories

Land slope (grade)	Plots in each slope category	Disease incidence	Seed cotton per acre
Percent	*Number*	*Percent*	*Pounds*
0 (level).....	8	1.4	674
1-2.....	16	12.8	524
3-4.....	16	27.3	351

Increased root rot incidence and decreased yield both appear to be associated with increasing land slope.

Small Population of Soil Microbes and Root Rot Disease Go Together

In an effort to isolate soil chemical and microbiological factors associated with land slope, and to determine effect of slope on cotton disease and yield, 92 soil samples from 24 plots were collected at the following depths: 0-6, 6-12, 12-18, and 18-24 inches. All soil samples are now being analyzed for total N and organic matter. Forty of the soil samples have been subjected to microbial enumeration. The samples were selected from two groups of five plots each, one group of which averaged high in disease and low in yield and the other low in disease and high in yield. The data are shown in the table below:

Microbial populations per gram of cotton root rot soils (oven dry) at various depths

The land			Microbial population by depths			
Land slope	Root rot incidence	Seed cotton yield per acre	0-6"	6-12"	12-18"	18-24"
Percent	*Percent*	*Pounds*	*Millions*			
0 (level).....	1.0 (low)	670 (high)	28	19	22	15
1-4.....	39.0(high)	275 (low)	17	14	14	13

Total microbial numbers at all depths down to 24 inches are distinctly greater in the high yield-low disease soil than they are in the low yield-high disease soil.

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Kansas. Downward movement and evaporation of moisture in relation to moisture conservation on a fallow soil. R. J. Hanks and F. C. Thorp, Manhattan.

Moisture Lost from Root Zone by Evaporation and Downward Movement

The purpose of this investigation is to determine the amount of moisture lost from the plant root zone by evaporation or downward movement under climatic conditions prevalent in the Great Plains. Tanks 2 feet in diameter and 6 feet deep were filled with a uniform silt loam soil. Fiberglass moisture units were placed at various depths for the measurement of soil moisture and temperature. Water sufficient to wet the soil in the tanks to three feet was added on May 19, 1954. A shed was built over the tanks but did not prove entirely effective. Available data show that evaporation affected the soil moisture

content to about 0.9 feet in 21 weeks and at least 1.5 inches of water were lost by evaporation in that time. The wetting front moved into the 2.9 to 4.8 foot zone of soil.

Agricultural Research Center

Plant Industry Station, Beltsville, Md. Legume inoculants. Lewis W. Erdman and Ura Mae Means.

Kura Clover Inoculated, Can Now be Tried as Soil Holder

Effective strains of rhizobia to inoculate Kura clover, Trifolium ambiguum M. Bieb., were isolated from nodules on T. ambiguum produced with six different soil samples. These samples came from the same general locality in Turkey where Kura clover is a native plant and were obtained through the courtesy of the Section of Plant Introduction.

Different single strain isolates were tested on T. ambiguum in greenhouse sand cultures, and marked variations in effectiveness to fix nitrogen and benefit the plants were noted. Three strains effective on T. ambiguum were shown to be ineffective or parasitic on red, white, sub, rose, crimson and Persian clovers. Plants from each replicate of the greenhouse experiment were transplanted to a field soil. This and other field tests made in 1954 were not conclusive due to unfavorable conditions, but additional field tests are to be made next year when new seed becomes available.

Trifolium ambiguum not only reproduces itself by forming seeds but also through underground stems or stolons. This suggests that it should be tested as an erosion-preventing crop.

Kura clover: Soil samples from Turkey failed to inoculate this legume, but enrichment cultures made from selected soil samples produced results shown on right. From nodules, pure cultures of rhizobia were isolated; these gave effective inoculation as shown on left.

HYDROLOGY

HYDROLOGY--GENERAL

Midwest

Wisconsin. Project: To determine rates and amounts of runoff from small agricultural watersheds, giving due consideration to soil types, cropping practices, and climatic and physiographic factors. Neal E. Minshall, Madison, Wis.

Peak Discharge from Small Watersheds in Wisconsin Estimated After Storm

There was very heavy precipitation in parts of Trempealeau and Vernon counties on the morning of July 3. Newspapers and radio reported serious flooding on the West Branch of the Kickapoo River and in the vicinity of Ettrick and Blair, Wis., as a result of this storm. Precipitation measured 4.5 inches at Cashton at the upper end of the West Branch of the Kickapoo and 5 inches at Blair. Both of these stations are standard gages and there is no actual record of intensities, but the reports are that most of the 4.5 inches fell in a period of one hour. Based on field surveys made shortly after the flood, peak discharges were estimated by the slope-area method. These data are summarized in the following table.

Estimated peak discharge (cubic feet per second) during storm of July 3 in Trempealeau and Vernon Counties, Wisconsin

County and stream	Location			Drainage area	Estimated peak discharge per second
	Sec.	Tn.	Rg.		
Trempealeau County				*Sq. Mi.*	*Cubic feet*
Reynolds Coulee	SE-29	21N	7W	2.3	2750
Peterson Valley	SW-24	21N	8W	2.7	2300
French Creek	SW-10	20N	8W	4.3	3900
Bear Creek	SE-4	20N	7W	0.85	550
Vernon County					
W. Br. Kickapoo	NE-31	15N	3W	1.0	1400
W. Br. Kickapoo	SW-31	15N	3W	2.0	2230
W. Br. Kickapoo	SW-7	14N	3W	6.8	6000
W. Br. Kickapoo	SW-30	14N	3W	20.0	6600
W. Br. Kickapoo	NE-6	13N	3W	28.0	8500
Tributary to W. Br	SE-30	14N	3W	5.0	2500

New Mexico and Arizona. Net water yield and sediment production studies, arid and semi-arid grassland watersheds in the southwestern United States. Walnut Gulch Watershed, Tombstone, Ariz., and Upper Alamogordo Creek Watershed near Fort Sumner and Santa Rosa, N. Mex. Robert B. Hickok, Project Supervisor, Albuquerque, N. Mex.

Storms Cause Work on Flumes; Soil and Range Data Collected

The hydrology investigations are being carried on by Willis C. Barrett, vegetative influences by J. Linton Gardner, and soil influences and sedimentation by Joel E. Fletcher. Purpose: To determine extent to which vast areas of privately-controlled rangelands in the low rainfall belts contribute to supplies of water for irrigation; and what effect conservation measures on these lands, to improve their forage production and reduce their erosion, would have on their net yields of usable water.

HYDRAULIC MEASUREMENTS (W. C. Barrett)--Walnut Gulch. By July 1, 1954, the measuring sections of flumes at five locations were complete and in operation. Their design capacities run from 2,100 to 8,000 cfs. A fairly complete network of raingages had been located on the watershed. Since work during the previous summer and winter seasons had been carried on without any break due to runoff, it was thought desirable to risk not completing the runoff measuring structures until some flow through a structure or two indicated the nature and extent of the riprap or other protective work required. However, by the middle of August the following situation developed:

The sequence of storms starting in July and continuing until late August were so frequent and their silt loads so great that heavy deposition occurred both above and below the structures. Islands of deposition in the upstream location directed heavy currents against the unprotected earth fills lateral to the concrete structures, and similar depositions downstream caused heavy diagonal or swirling currents to impinge on and damage the unprotected lower surfaces of the earth fills. For such heavy silt loads the three larger structures appeared to be too low.

The frequency and size of the storms so stalled the construction work that but one of the smaller structures was sufficiently protected against scour. By August 6, two of the largest flumes were put out of commission. Later only two flumes were in operation - one in good shape, the other intact down to the critical cross section of the flume - but, beyond this, seriously damaged. Considerable valuable flow records were obtained.

The measuring flumes are presently undergoing model tests at the Stillwater, Oklahoma, Outdoor Hydraulic Laboratory to determine the hydraulic and structural characteristics of the prototypes. Another product of the tests will be rating curves relating gage height to discharge.

Alamogordo Creek. Work began on the main outlet flume in June 1954 on Alamogordo Creek, and by September 1 a recorder was in operation. The flume has a design capacity of about 9000 cfs, and to date it has operated satisfactorily under moderate flows.

A survey of the channel above and below the structure is being made to provide information for simulating the installation in some model studies to be undertaken at the Stillwater laboratory.

SOIL INFLUENCE AND SEDIMENT MOVEMENT (Joel E. Fletcher)--Walnut Gulch. Tentative data from soil samples taken on this watershed indicate that about 62 percent of the soils of the watershed are erodible in character and thus potential sediment producers. Either caliche or bedrock is found in the profiles of 71 percent of the soils. This means the saturated infiltration capacity would be very low. Thus, the watershed should be a very efficient water producer. Soils may be classed as those on bedrock--12 percent, those with caliche--59 percent and those which are apparently well drained--29 percent. This work is in the preliminary stages.

From the soil samples taken in the spring in conjunction with the vegetative studies, it was found on subwatershed 5 that 26 percent of the soils had very erodible surfaces when the vegetation and erosion pavement were removed. Classed as moderately erodible surfaces were 52 percent and stable surfaces, 22 percent. This picture was modified by

the fact that 65 percent of all the soils were covered with a protecting coat of erosion pavement. Unfortunately, those surfaces which showed least stability were in the 35 percent of the soils which were not protected to any degree by erosion pavement.

The percentage of the soils from this subwatershed having either caliche or bedrock under them was greater than on the watershed as a whole - 81 percent for area 5 and 71 percent for the whole. This would indicate that the wet infiltration in that subwatershed would be lower than that of the watershed as a whole.

The whole watershed had soil pH ranging as follows: pH 6-7, 7 percent; pH 7-8, 24; pH 8-9, 68; and pH 9-10, 1 percent. In contrast to this, subwatershed 5 had only 13 percent pH 8 or lower and 87 percent in the range pH 8-9.

VEGETATION INFLUENCES (J. L. Gardner)--Alamogordo Creek. In cooperation with the Soil Conservation Service, a survey of range condition and class has been almost completed. It is expected that, besides furnishing an inventory of range resources, this survey, in conjunction with one on the soils, will afford a basis for subdividing the area to study effects of different types of vegetation and soils on sediment production and water yield.

Although drought of several years' duration continued during the summer in this area, with the result that flowering of plants was less than usual, a herbarium collection was started, and some of the determinations have been made.

Walnut Gulch. Additional herbarium collections were made here during the summer. Owing to the very wet season experienced in this section, many plants that were rare or were not seen at all in 1953 appeared to be common this year. This was true not only of such annuals as the morning glories and certain grasses, but, surprisingly, of some perennials as well--e. g., the mala mujer or bull nettle, which was unobserved last year but was relatively common over rather wide areas this year.

A start has been made toward working up the data from the vegetation survey of this area.

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New Mexico and Arizona. Flood runoff studies, arid and semi-arid watershed in the Southwestern United States. Flood study watersheds near Albuquerque, New Mex., and Safford, Ariz.; net yield study watersheds near Tombstone, Ariz., and Fort Sumner, New Mex. R. B. Hickok, Albuquerque.

Flood Characteristics of Arid Watersheds Discussed in New Reports

Purpose: To provide basis for (a) estimating flood expectancies for the design of soil and water conservation and flood prevention structures and practices; and (b) evaluation of their effects.

Analyses of accumulated 15 years' basic data from 14 flood study watersheds were continued. A special report series has been started to cover separate phases of flood runoff data analyses on a current basis. These special reports are intended for record and for limited distribution to permit immediate trial use of the hydrologic design data and to secure criticisms and suggestions for subsequent publication of the material. Reports completed in this special series are:

No. 1 Introduction to Special Report Series on Flood Runoff Studies
No. 2 Hydrographs, Rainfall Intensity Graphs, and Runoff Accumulation Graphs
No. 3 Determination of Watershed Lag Times
No. 4 Correlation of Measured Lag Times with Basin Characteristics
No. 5 Water Yields from Small Experimental (Flood Studies) Watersheds in Arizona, Colorado, and New Mexico

Two additional reports now in process will cover (1) Flood Runoff Expectancy Estimates; and (2) Dimensionless Runoff Hydrographs and Summation Graphs. Several others are planned.

As discussed in Progress Report No. 4, Correlation of Measured Lag Times with Basin Characteristics, certain hypotheses and conclusions may be drawn from the formulations for small arid and semi-arid watersheds:

1. The slope of the land is of much greater importance than the slope of the main channel.
2. The peak rate and time of runoff may well be controlled by a part of the watershed. Landslope variation commonly determines the source area in such cases.
3. Shape as well as size is reflected in the final formulation, as it reflects average total distance of travel.
4. A great deal of the travel of the water from the source area to the point of collection may be via subsidiary channels below the source area. Also, the degree of dissection may determine to what extent areas other than the main source area contribute to the peak. This may explain the apparent necessity for using the drainage density for the entire watershed rather than for only the source area.
5. The average landslope generally provides a satisfactory approximation for the landslope of the source area because the source area is included and must be an important portion of the total area.

LAND USE INFLUENCES

Midwest

Michigan. Effect of land use on the hydrology of farm lands under varying types of snow cover and frozen soil. George A. Crabb, Jr., Supervisor, Michigan Hydrologic Research Station, East Lansing.

Causes of Runoff--Rain, Snow, Both--Quite Evenly Divided

Analysis of runoff data from the three watersheds represents the greater part of the quarter's analytic effort. It was found that during the 13 1/2-year period between January 1941 and June 1954, the three watersheds of the Station produced 488 runoffs. A breakdown of this total, by cause of runoff, shows that 163 (33.4 percent) were the result of rain, while snowmelt caused 147 runoffs (30.1 percent). Rain in combination with melting snow caused 178 runoffs (36.5 percent).

Distribution of the runoffs, by cause, from the two cultivated watersheds (without regard to soil cover) was about the same for both although the rotations were different during most of the period. Distribution of runoffs, by cause, at the wooded watershed was somewhat different. Rain caused 18 runoffs, 47.4 percent; snowmelt, 3 runoffs, 7.9 percent; and rain and snowmelt in combination caused 17 runoffs, 44.7 percent. The three watersheds produced runoffs as follows during the period: Watershed A, 227; Watershed B, 223; and Wooded Watershed, 38.

Runoff occurrences by months were about the same on Watersheds A and B, which were planted to agricultural crops. The pattern at the wooded watershed was different in detail but generally the same as at the cultivated watersheds. The greatest number of runoffs have occurred during the month of March (33.4 percent), closely followed by February (21.5 percent), and January (13.9 percent). The importance of the intermittent freezing-thawing cycle during this period is clearly demonstrated as a causative factor of runoff. Nearly 70 percent of all runoffs have occurred during the first quarter of the year, while approximately 87 percent of all runoffs have occurred during the first half of the year.

Nebraska. To study the effect of land use and soil conservation practices on runoff from small watersheds. Central Great Plains Experimental Watershed, John A. Allis, Project Supervisor, Hastings.

Storm Runoff from Small Watersheds Seen Closely Related to Land Use

A continuous record of measured runoff is being kept on 24 small watersheds of approximately 4 acres each in south-central Nebraska. Of these, 21 are farmed as fields in a corn, oats, wheat rotation in straight rows, on the contour, and in a stubble mulch system of farming. The other three watersheds are in native grass, two of them in meadow and the remaining one in pasture.

Monthly rainfall at the meteorological station was as follows: July 0.95 inches, August 4.26 inches and September 1.50 inches.

The largest and most intense storm occurred on the morning of August 17 when about 0.7 inch fell in 20 minutes, followed by about 0.2 inch in the next 3-hour period. Short, intense local storms of this nature are quite typical in the Great Plains, especially during the summer months when it is hot and dry.

In these local downpours, the differences in peak rates and total runoff due to land use practices may be quite significant.

At the time of the storm (August 17) the corn was about 72 inches high, tasseled and the ears were in the milk stage. The oat watersheds had been plowed or subtilled, but not harrowed, in preparation for wheat seeding in September. The wheat watersheds had been combined in July and the land was in stubble with some weed growth.

Runoff from 24 small watersheds in South Central Nebraska: Average peak rates (inches per hour) and average total runoff (in inches) associated with different land use practices, storm of August 17, 1954

Crop	Straight Row		Contoured		Subtilled	
	Peak rate	Total runoff	Peak rate	Total runoff	Peak rate	Total runoff
Corn	1.20	.18	.46	.09	.39	.07
Oats*	.16	.03	.36	.06	.05	.01
Wheat (stubble)	1.49	.22	.36	.10	.62	.09

Native grass pasture: Peak rate--.06; average rate of total runoff--.01.
Native grass meadow : No runoff.

*Oats had been harvested and land plowed or subtilled, but not harrowed.

There was some variation in the runoff from individual watersheds which were in part due to differences in stands, not being able to do a good job of farming immediately above the flumes, and other factors. These results, however, show for a short, intense rain of less than 1 inch in August of this year that:

1. The average peak rate of runoff from straight row wheat stubble was about 1.5 inches per hour and was only about 0.6 inch per hour from subtilled stubble land and about 0.4 inch per hour on contoured stubble.
2. The total runoff from the contoured and subtilled wheat stubble land was less than half that from wheat stubble in straight rows.
3. Both the peak rates and total runoff from corn on the contour and subtilled was less than half that from straight row corn.
4. The total runoff from plowed, but not harrowed, land was less than .06 inch.
5. There was no runoff from meadow land and pasture land showed only .01 inch total runoff.

* * * * *

Texas. Effects of land use on soil moisture and dollar returns on watershed basis. J. B. Pope, Blacklands Experimental Watershed, Waco.

Conservation Practices Give Substantial Advantages in Dry Year

In spite of extreme drought conditions, conservation practices as used on the major portion of the Y area resulted in returns of $9.63 more per acre than the conventional practices on Area W.

At the end of the quarter soil moisture conditions were nearly the same in all areas regardless of crop or treatment with little or no available moisture.

For the three months ending September 30, rainfall was 3.21 inches compared to a normal of 7.35 inches. This low rainfall followed 11.16 inches compared to a normal of 19.60 inches for the first 6 months of 1954. The only rains of this period of value to crops were 1.50 inches July 30-31 and 1.08 inches September 30. These rains were too late in the season to have much effect on crops other than late cotton and pastures. There was no runoff from any area during this period.

Crop Yields. --The 1954 crop yields as a whole were low this season due to the prolonged drought. Moisture was a limiting factor. However, there were substantial yield differences in favor of the recommended conservation practices over the conventional practices. Comparisons between the Y area with conservation methods and W area with ordinary methods of farming in 1954 were as follows:

1954 Crop Yields per acre

	Lint cotton	Corn	Grain sorghum	Oats	Cropping system
	Pounds	*Bushels*	*Pounds*	*Bushels*	
Y-Area Conservation practices.	238	40.6	1631	46.7	Oats with clover, cotton, grain sorghum or corn with 200 # of 16-20-0 fertilizer on oats and clover.
W-Area Ordinary practices.....	174	25.4	1283	30.9	Cotton, oats, cotton, corn-no legume or fertilizer.

Amounts by which Area Y surpassed Area W

	Lint cotton	Corn	Grain sorghum	Oats
Yield (per acre).....	64.0 lbs.	15.2 bu.	348 lbs.	15.8 bu.
Yield (increase).....	36.8 %	59.8 %	27.1 %	51.1 %
Market value.....	$21.12	$19.01	$7.31	$13.11

The conservation plan reduces the acreage of cotton and increases the acreage of corn and oats. For 100 acres of crop land the total yields and values at harvest time were as follows:

Conservation plan		Ordinary practices	
33-1/3 acres cotton--7933 lbs.	$2618	50 acres cotton--8700 lbs.	$2871
33-1/3 acres corn--1353 bu.	1692	25 acres corn--635 bu.	794
33-1/3 acres oats and clover--1557 bu.	1292	25 acres oats--772 bu.	641
100 acres	$5602	100 acres	$4306

On the conservation area fertilizer and seed worth $10 per acre were used with the oats but none on the other crops. This is an additional cash expense of $333. The net increase in income from the 100 acres with conservation practices is $963 or the equivalent of $9.63 per acre. No value has been placed on the extra grazing value of the fertilized oats on the conservation area, but it is considerable and probably would be sufficient to pay most of the fertilizer cost.

Soil Moisture.--A crop season summary of available moisture is given in the table that follows:

Although corn and grain sorghum are used interchangeably in our rotations, corn grows faster than sorghum and uses more water early in the season. The total water requirement is probably not greatly different.

Oats had used practically all available water prior to rains April 28 to May 4, totaling about 3 inches. Oats at this time were mature but the clover grown with oats in the conservation practice area continued to use water until plowed early in July. The increased production from the conservation area probably accounts for the lower moisture condition at the end of the season.

Available moisture at beginning and close of 1954 crop season on cultivated fields in Area Y-10 (conservation practices) and Area W-10 (ordinary practices), by crops, soil depths, and sampling dates*

Area and crops	0-6" depth		6-12" depth		12-24" depth		24-36" depth		0-36" total	
	May	Sept.	May	Sept.	May	Sept.	May	Sept.	May	Sept.
Y-10	*Inches*		*Inches*		*Inches*		*Inches*		*Inches*	
Cotton	1.015	.000	.858	.000	1.982	.000	1.949	.101	5.804	.101
Sorghum	.886	.000	.905	.000	1.932	.000	2.100	.134	5.823	.134
Oats & clover**	.792	.000	.835	.125	1.294	.638	.454	1.142	3.375	1.905
All									15.002	2.140
W-10										
Cotton	1.044	.000	1.139	.125	2.503	.370	2.453	1.008	7.139	1.503
Corn	.605	.072	.546	.086	1.058	.269	.722	.302	2.931	.729
Oats**	.821	.343	.811	.507	.756	1.025	.823	1.025	3.211	2.900
All									13.281	5.132

* Sampled May 14 and Sept. 22

** Oat stubble in September

Northeast

New York. Sedimentation control through streambank stabilization.
D. A. Parsons, East Aurora.

Proper Positions for Revetments Indicated by Observations on Buffalo Creek

Many people concerned with the regulation of streams have observed that bank erosion occurs along the outside of bends and that stream channels tend to migrate down-valley by erosion of the down-valley bank, with concurrent deposition of material along the opposite shore. It follows that a stream channel can be completely stabilized by providing non-erodible revetments along the outside banks of bends and along the entire down-valley bank, provided the upper end of the stabilization work is tied to an already stable channel or extends completely from one valley wall to the other, and provided also, that degradation or aggradation in the channel is not excessive. It also follows that any problems with the up-valley bank or the inside of a bend below the apex have to do with deposition and the maintenance of adequate channel capacity. Exceptions to the latter may be removal of channel obstructions such as large trees, stumps and islands that might deflect the flow and cause erosion of an otherwise stable bank; bank protection below a natural or artificial channel restriction or drop in the bed that causes a large increase in velocity; and bank protection opposite a tributary that crowds the main stream with an excessive amount of heavy bed material.

Another common-sense rule for streambank stabilization is to revet those banks that appear to be eroding. The high costs of permanent bank protection however, make refinements in these simple revetment rules necessary. In this connection, the following observations made along Buffalo Creek Channel in Western New York are applicable:

The deepest point along a bend in a stream is almost always near the eroding bank and may logically be associated with the point of major attack on the bank by the stream. Surveyed cross-sections of the unstabilized channel showed the locations of these points to be dependent in part upon the radius of the eroding bank of the bend. In a short-radius bend of from 1-1/2 to 2 times the stream width, the point of maximum depth was about one-half the stream width downstream from the intersection with the eroding bank of the extension of a straight line representing the upstream, opposite eroding bank. With a bend radius of 4 to 5 times the stream width, the corresponding distance was about equal to the stream width.

A 60-year flood on May 26, 1953, damaged some of the short and medium-radius, riprapped banks in the upper reaches of the Creek. The range in damages in the upstream portion of the bends extended from the aforementioned point of intersection to 1-1/2 times the stream width downstream.

The upstream point along an eroding bank at which to begin stabilization work is an important consideration. Observations were made along portions of the creek that had been stabilized from 1 to 4 years. The stream generally continued to deposit material and build up the up-valley shore. The downstream point of this deposition along the outside of a bend may be considered to be the point below which permanent-type stabilization work is effective and above which there is no need for it. The data were somewhat erratic but the tentative conclusion is that, when the approaching stream is directed down-valley, almost the entire bend needs to be stabilized but, when the approaching stream is directed perpendicular to the valley direction, the stabilization work needs to begin only about one-fifth the stream width above the extended line of the upstream opposite bank.

##Report coming. --The foregoing statements briefly cover the principal material in a longer report that will soon be made available.

Great Plains

Kansas. Sedimentation studies. Louis M. Glymph, Jr., Project Supervisor, Lincoln, Nebr.

Sedimentation Re-survey of Mission Lake, Brown County, Kansas, Is Made

Mission Lake was completed as a water supply reservoir for the City of Horton, Kansas, in May 1924. It had an original storage capacity of 1,852 acre-feet, a surface area of 169 acres, and a drainage area of about 8 square miles. In May 1937, after 13 years of use, the SCS made a sedimentation survey of the reservoir as a part of its then-current program to develop regional indices of sediment yield and rates of reservoir silting. The survey showed a total sediment accumulation of 289 acre-feet, representing an average of 5.38 tons per year per acre of contributing drainage area. Results of this survey have been used frequently during the past years as one indication of sediment yields in Northeastern Kansas.

A resurvey was made during the period July 7-30, 1954, by personnel supplied by ARS, SCS, and the City of Horton. The resurvey extends the period of sediment record to 30 years and provides a basis for comparisons between the first and second periods. Mission Lake is located in the Little Delaware-Mission pilot watershed being developed by SCS, and studies are being projected for the future as a part of evaluations of the watershed conservation and development program.

Results of the resurvey have not been computed but will be reported as soon as they are available.

* * * * *

Texas. Silt load of Texas streams. Roy Carpenter, Austin.

Streams' Silt Load Low During Drought; Report Published

During the quarter ending September 30, silt samples were taken at the 24 regular silt sampling stations. The drought has continued and as a consequence the quantity of silt has been very low. Three rivers (Guadalupe, Perdenales and Leon) have ceased to flow or are "dried up." However, scattered thunder showers have produced a significant amount of silt at various stations. Torrential rains will cause severe damage to denuded ranges and cropland. The rivers and reservoirs will catch a tremendous amount of silt.

The fifteenth annual report, The Silt Load of Texas Streams, covering the water year of October 1, 1952, to September 30, 1953, will be published in October.

HYDRAULICS

Great Plains

Oklahoma. To obtain data needed for the hydraulic design of channels and structures for soil and water conservation. W. O. Ree, Stillwater Outdoor Hydraulic Laboratory.

(1) Foliage Increases "n" Values in Terrace Channels

Study: Determination of the hydraulic characteristics of crop vegetations in very light slope channels.

The calculations were completed for the second of the wheat tests. The wheat in the test channel was Pawnee planted in 7-inch rows. The rows were parallel to the length of the channel. At the time of testing, the grain averaged 28 inches in height and was nearly

mature with only 12 percent of the heads still green. The stand was good, averaging 26 stems per foot of row.

Tests were made at 10 different depths of flow ranging from about 0.5 foot to 2.2 feet. The flow direction was with the rows. At the smallest depth Manning's "n" was .12. As the flow depth increased the retardance coefficient increased until it reached .165 for a depth of 1.5 feet. Further increase in flow depth was accompanied by a decrease in Manning's "n" to .11 at the maximum depth tested. At the deepest flow the wheat was submerged but remained nearly erect in the flow being slightly inclined in the downstream direction.

The wheat was removed and the two test channels were planted to sorghum. One channel was planted to Redlan Kaffir, a short variety, and the other to Hegari, a tall variety. Both were planted in 40-inch rows. The rows were parallel to the length of the channel. The channels were irrigated and cultivated during the growing season.

The channels were tested early in September. At that time the crops had achieved maximum foliage and hydraulic resistance was likely at its greatest. The results of the tests on the Redlan Kaffir will be given here since the analysis of the data is complete.

At the time of testing the Redlan Kaffir had just headed out. Its average height was about 42 inches to the top of the head and about 31 inches to the top of the leafy portion. Stalks had a base diameter of 1 to 1-1/4 inches and averaged about 2-1/4 stalks per foot of row. The rows were 40 inches center to center.

Nine flow tests were run, ranging in depth from 0.5 foot to 1.9 feet. Flows were parallel to the row direction. For the smallest depth the value of Manning's "n" was .042. It then increased with depth, resulting in values of .057, .080, and .108 at depths of 1 foot, 1.5 feet, and 1.9 feet, respectively. The increase in "n" is attributed to the increasing amount of foliage encountered.

(2) Switch Grass in Channel Test Rates in Retardance Class C

Study: Determination of flow-retarding properties of different vegetations.

Flow tests were run on a channel planted to switch grass (Panicum virgatum) Blackwell strain. The cover was poor; the average ground density, as measured by the line transect method, was only 3.2 percent for the switch grass and 0.5 percent for the other species. The height of the grass was 24 inches. It had not begun to form seed heads at the time of testing. The channel in which the tests were made had a bottom width of 6 feet, side slopes of 3-1/2 to 1, and a bottom slope of 8 percent. The flow tests showed the cover to fall just below class C in the retardance class. The channel showed little damage to the bed following a flow at a velocity of 4.3 feet per second. However, the next run at a mean velocity of 6.2 feet per second resulted in excessive scour. It should be noted at this point that the soil in the channel bed was a clay loam.

(3) Friction Factor for Corrugated Pipe Increases in Year

A test was run on the existing setup to determine if any changes had occurred in the corrugated pipe friction factors since the last tests made 1 year earlier. This test showed the Darcy-Weisbach friction factor for the 18-inch corrugated pipe, full coated and with paved invert, to be .085. This compares with the value .067 obtained from the tests made 1 year before. The increase is believed due to the checking and roughening of the invert paving and also to the melting of the asphalt coating at the top, causing the formation of "tear drops." The pipe is exposed and is located on a south slope. This hastens the deterioration of the coating.

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